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FLIGHT

The AIRCRAFT ENGINEER & AIRSHIPS

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A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

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EDITORIAL COMMENT

"I KNOW I am a voice crying in the wilderness, but I very much doubt whether we are really on the right track in concentrating, for our commercial aircraft, on the three-engined type." This remark was made to us recently in conversation with a famous aircraft designer, a man whose name is known throughout the world. One has come to take the three-engined arrangement so much for granted that such a remark, coming from a man who unquestionably "knows what he is talking about," has the effect of pulling one up rather abruptly. Mathematicians have proved that sufficient freedom from forced landings is attained, for all practical purposes, by arranging the power plant of an aircraft in three separate units, and giving it such power that the machine is able to continue its flight with any one of the three engines stopped. Imperial Airways, certainly not a body of mathematicians, have selected the three-engined type, and may be assumed to have done so as a result of practical experience. Other aircraft operating firms have done, or are doing, the same. One might, therefore, have thought that the effectiveness of the three-engined arrangement for avoiding forced landings had been conclusively demonstrated, and that there could no longer be any discussion on that point.

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Yet we have an authority still doubting that this is so. And he bases his arguments on considerations somewhat as follows : In proving "mathematically" that in a three-engined aircraft capable of flying on any two of its three engines, the assumption is made firstly that each of the three individual installations is as reliable as the installation of the single-engined type. That this is a fact he very much doubts. The petrol supply is somewhat complicated by having three separate units to feed. The wing engines are regarded as being more liable to disturbance in their installation and equipment than the fuselage engine of a single-engined machine. It would be interesting to learn the experience of Imperial Airways in this respect. Cases of engine failure must have occurred since the adoption of

three-engined machines, and the statistics, which no one but Imperial Airways possesses, should show whether or not a greater percentage of failures took place with the wing engines than with the central engines. Due regard should, of course, be had to the fact that there are twice as many wing engines as there are central engines.

Another point which was raised was that in their calculations the mathematicians failed to take into account the fact that as soon as one engine fails, the power of the other two must immediately be increased to full power in order to keep the machine aloft, and that in doing this, the chances of one of the remaining engines failing are greatly increased.

That the three-engined machine must be less efficient aerodynamically than the single-engined is not, perhaps, disputed. And the arguments against the assumed reliability (in the form of freedom from forced landings) of the three-engined type are probably quite sound. The designer whose views we have quoted points out that if the same power surplus is available in the single-engined type, and a little extra weight put into the engine, its installation and accessories, the reliability should be as good as that of the three-engined machine. There is, however, another side to the question, which has little to do with the problem of reliability. It may be accepted that for commercial work, on the main routes at any rate, we want large machines. The present types have a total power of close upon 1,500 h.p. At the moment no power unit is available which develops this power, and even if it were, there is the problem of absorbing efficiently such powers by a single airscrew. In other words, the thrust horsepower delivered by a single unit of such large power might be less than the combined thrust horsepower of three smaller units. There are, of course, many other arguments for and against the three-engined machine, but this is not the place to discuss the matter fully. All we can do here is to call attention to the fact that there are still those who remain unconvinced that the three-engined arrangement is necessarily the ultimate solution. We should very much like to have the views of others on the subject, and if Imperial Airways could, for once, be persuaded to supply statistics, these might go a long way towards settling the question once and for all.

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Fuel from Coal

The demonstration which was to have taken place at Stag Lane aerodrome last week of flying on the new fuel produced from coal was prevented by a thick fog, which made flying impossible, but actually this mattered very little, as the engines of the machines were successfully started on the new fuel, and previous flying tests had indicated that there was no appreciable difference in power when using this fuel. The smell is said to be very unpleasant, but it is thought that this difficulty may be overcome.

The importance of the new fuel lies, of course, in the fact that, should its commercial production prove feasible, this country would be independent of foreign supplies, a state greatly to be desired in time of war. Moreover, the new process might very well prove the salvation of the British coal industry, and directly and indirectly give work to thousands who are now idle. The importance of this can scarcely be over-estimated, and the new venture deserves every encouragement that can possibly be given. It still remains to be seen whether the engines suffer any ill effects from prolonged use of the fuel, and as regards aircraft whether approximately the same power and mileage per gallon can be obtained as with ordinary petrol. The question of cost will also naturally be of importance, although this will presumably be largely governed by the amount produced. It is to be expected that if and when the new process really "gets going," the price of petrol will be reduced, and thus future competition must be based upon a comparison between the new fuel and the lower price of petrol which may be expected, and not between it and the price of petrol today. The possibilities are interesting, and future development should be closely watched.

❖ ❖ ❖

His Majesty's Message

Aviation folk may justifiably feel pleased and honoured that the first message signed by His Majesty the King since his severe illness should have been one of congratulation to the Royal Air Force on their splendid work in evacuating so many people of different nationalities from Kabul. His Majesty has ever taken a keen interest in aviation, and his message to Sir Samuel Hoare expressing his admiration for the work of the R.A.F. in Afghanistan will be cherished by the Royal Air Force in particular, but also by the British aviation community in general, who will, one and all, join in respectfully expressing the hope that His Majesty's health may be quickly and fully restored.

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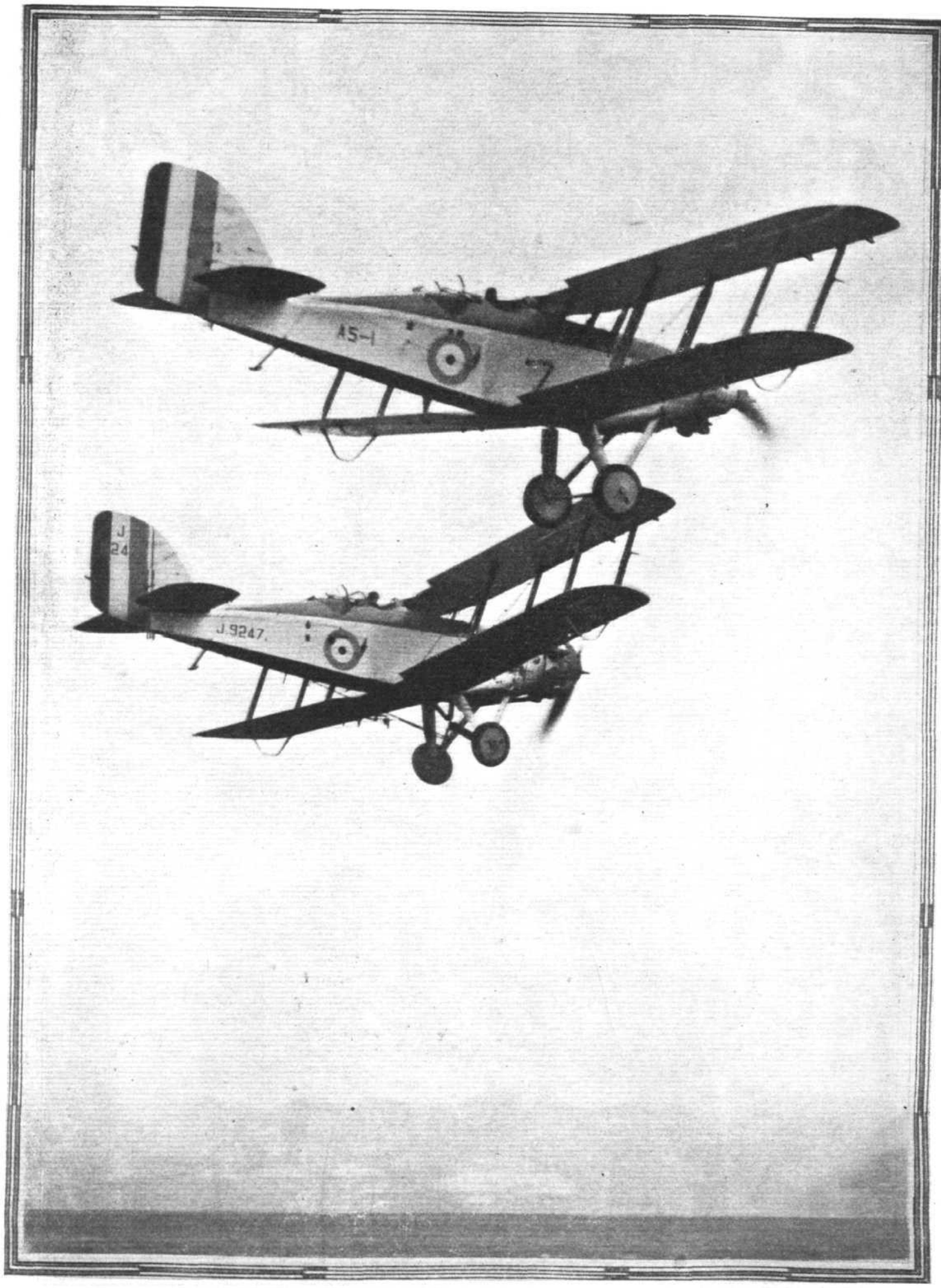
Two British Flights

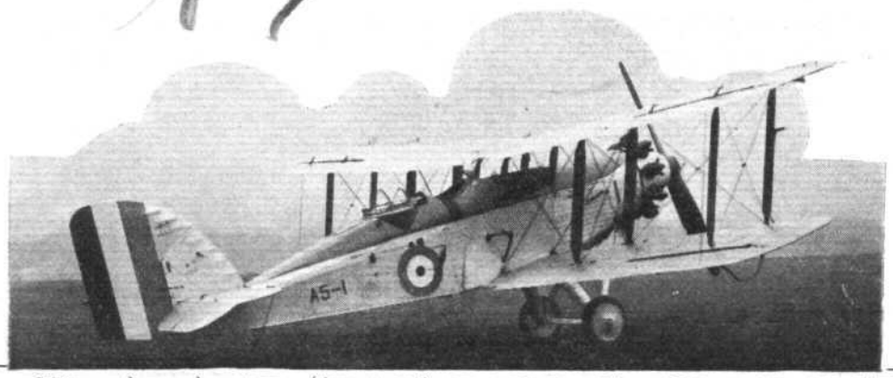
Two British flights of great importance are due to start in the near future. The Fairey monoplane with Napier "Lion" engine will, it is rumoured, start from a Lincolnshire aerodrome within a few days to attempt to beat the existing world's record for a flight in a straight line. The Air Ministry refuses either to confirm or deny the rumour, and so one is forced to the conclusion that there is probably "something in it." No detailed information concerning the amount of petrol which the Fairey monoplane is capable of carrying has been allowed to become published, but it is fairly certain that it is, as the official statement had it, "more than 1,000 gallons"—a good deal more, and the chances of success should be very good.

The second flight in a British machine is that to Australia in a Vickers "Vellore" with geared "Jaguar" engine. This flight will probably not take place for some little time yet, as there are certain preparatory arrangements to be made, but the start should take place in a few weeks. The Vickers "Vellore," it may be remembered, has an extraordinarily high pay load for its engine power, and for the flight to Australia some of this load-lifting capacity will be used for petrol, as although no "stunt" flights are contemplated, there are several stages over which flights of many hundred miles are necessary. The flight should be regarded as a reliability flight pure and simple, and there is no question of breaking any records. For all that, it should, if successful, do much to increase British prestige, apart from demonstrating the qualities of the machine and engine directly concerned. This is especially so as the machine will at no stage of the flight be loaded above the weight of its certificate of airworthiness. Thus the demonstration will be all the more convincing in its commercial possibilities.



["FLIGHT" *Photograph*

THE R.A.F. AND THE R.A.A.F. : Mr. Brunton and Mr. Penrose, of the Westland test pilots' staff, "formating" on two "Wapitis," of which one is for the British Royal Air Force and the other (nearest camera) for the Royal Australian Air Force.



FIRST R.A.A.F. "WAPITI" CHRISTENED

YEOVIL was the scene, on February 21, of a great deal of aerial activity. The first of the 28 "Wapitis" ordered for the Royal Australian Air Force from the Westland Aircraft Works (branch of Petters, Ltd.) was to be christened by Lady Ryrie, wife of Major-General Sir G. de L. Ryrie, High Commissioner for Australia, and the occasion was celebrated in a most fitting manner by the Westland company sending invitations to a large number of distinguished people representing Australia, the Air Ministry, various British aircraft firms, and foreign naval, military and air attachés, as well as representatives of the Press.

Most of the visitors (of whom there were nearly 200) arrived by train from London, and were conveyed to the Westland works by large numbers of motor cars. Here they were received by Sir Ernest Petter, Mr. P. W. Petter and Mr. R. A. Bruce, and divided into parties each under competent guidance of a member of the Westland staff, and a tour of inspection of the extensive works was made. To those of us who have had the privilege of knowing the Westland Aircraft Works since their first beginning, it was most refreshing and encouraging to find the great amount of work that is now being done. For many years this firm has struggled along with but scant encouragement, and with barely sufficient work in hand to keep alive. Mr. R. A. Bruce, managing director of Westlands and a director of Petters, Limited, and his co-directors have, however, never lost faith. Ever the designing office was busily engaged upon some new type, and for each disappointment in the form of lack of orders, the firm figuratively tightened its belt and worked harder than ever. Mr. Davenport, the chief designer, and his assistants were never at a loss for ideas, and "the firm" backed them up with the necessary capital. Again came disappointment, but no slackening of effort. At last came the "Wapiti," and with it came instant and convincing success. The type was adopted first for use

["FLIGHT" *Photograph*

CHRISTENING THE FIRST "WAPITI" FOR THE ROYAL AUSTRALIAN AIR FORCE: Lady Ryrie, wife of Major-General Sir Grenville de L. Ryrie, High Commissioner for Australia, performing the christening ceremony at Yeovil.

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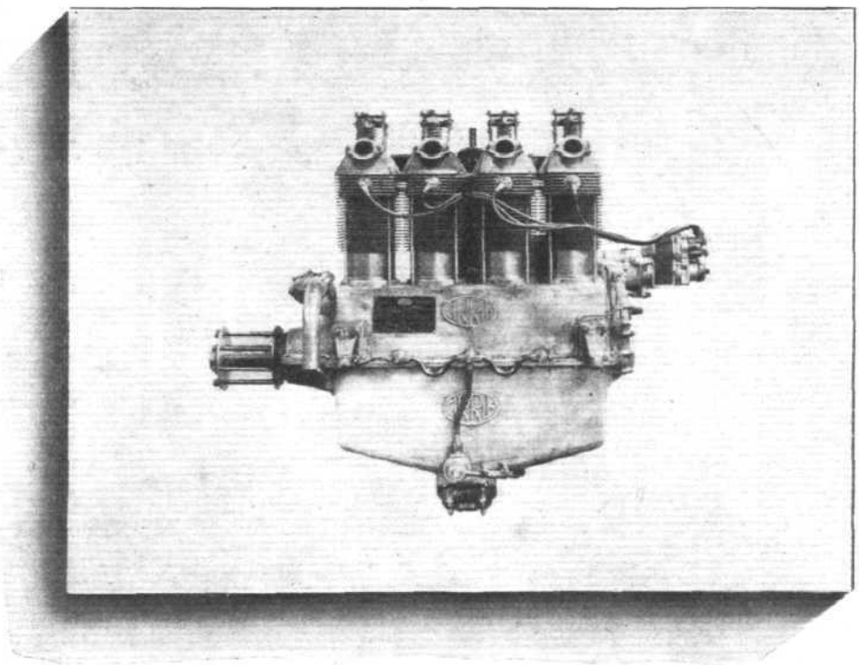

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by the British Royal Air Force, and later, on the recommendation of Air Marshal Sir John Salmond, by the Royal Australian Air Force, for which a batch of 28 " Wapitis " was ordered. The R.A.F. has large numbers on order, and it is to be expected that other Dominions will follow suit, so that it is small wonder that one way and another, the " Wapiti " is making up to Westlands for the many lean years of the past.

During the visit of inspection one saw " Wapitis " in various stages of completion, the all-metal construction of the machines for the R.A.F. contrasting with the wood wings of the machines for Australia, where this form of construction is still preferred due to local facilities for repair. That the " Wapiti " deserves its title of " General Purposes " machine was also brought out by the fact that its standard fittings provide for the substitution of a float undercarriage for the standard land undercarriage, thereby converting the machine into a seaplane. Yet another adaptation has a ski undercarriage, so that what with the excellent qualities of the " Wapiti " as a service type of aircraft and its adaptability to operating from land, water or snow, its popularity is readily understood.

Other types of Westland aircraft seen in the shops included the new three-engined limousine (described and illustrated elsewhere in this issue), the " Widgeon " light monoplane, for which an improved undercarriage has now been produced, the skeleton of the new all-metal " Widgeon," and the Westland-Hill " Pterodactyl " tailless monoplane with Armstrong-Siddeley " Genet " engine.

After the tour of the works, the visitors were entertained to luncheon at the Town Hall. Sir Ernest Petter, chairman of Petters, Limited, presided. On behalf of the directors he extended a hearty welcome to what he described as a " distinguished gathering such as his native town had never seen before," representative as it was of the interest taken in aviation in almost every country in the world.

He thanked Lady Ryrie for coming to Yeovil to christen the first " Wapiti " and regretted the absence abroad of her husband, Sir Grenville Ryrie. Referring to the " Wapiti," Sir Ernest said that only those in close touch with aviation knew how many disappointments and how many years of development work it took to produce one successful machine. They owed much to the producers of the famous Bristol " Jupiter " engine which had made the " Wapiti " such a reliable machine, and he was glad to welcome that day Sir Stanley White, managing director of the Bristol Aeroplane Company.

In conclusion, Sir Ernest referred to the presence of their M.P., Maj. Davies. He had received letters from a number of people regretting that as they were suffering from influenza they would not be able to be present. He then said to himself " Well, there is one man who won't fail us, and that is Maj. Davies. No M.P. would fail us a month or two before the general election (laughter).

Lady Ryrie apologised for the absence of her husband, who was now on his way back to England, and who joined with her in wishing *her* " Wapiti " every success in Australia. She spoke of the great possibilities which Australia has for flying, with its good landing grounds and great visibility. She shought it would not be long before everyone in Australia had their own little light 'plane.

The party then returned to the aerodrome, where a number of Westland machines of various types were lined up. Lady Ryrie performed the christening ceremony, not without difficulties, as the bottle of champagne had a remarkably high factor of safety, and Flight-Lieut. Paget, Westland's chief test pilot, then took the newly-christened baby for a flight, demonstrating the machine to be exceptionally manœuvrable. A little later, two other Westland pilots, Messrs. Brunton and Penrose, went up in two " Wapitis," the Australian A5-1 and another belonging to the R.A.F., and gave a very excellent display of " formation flying."

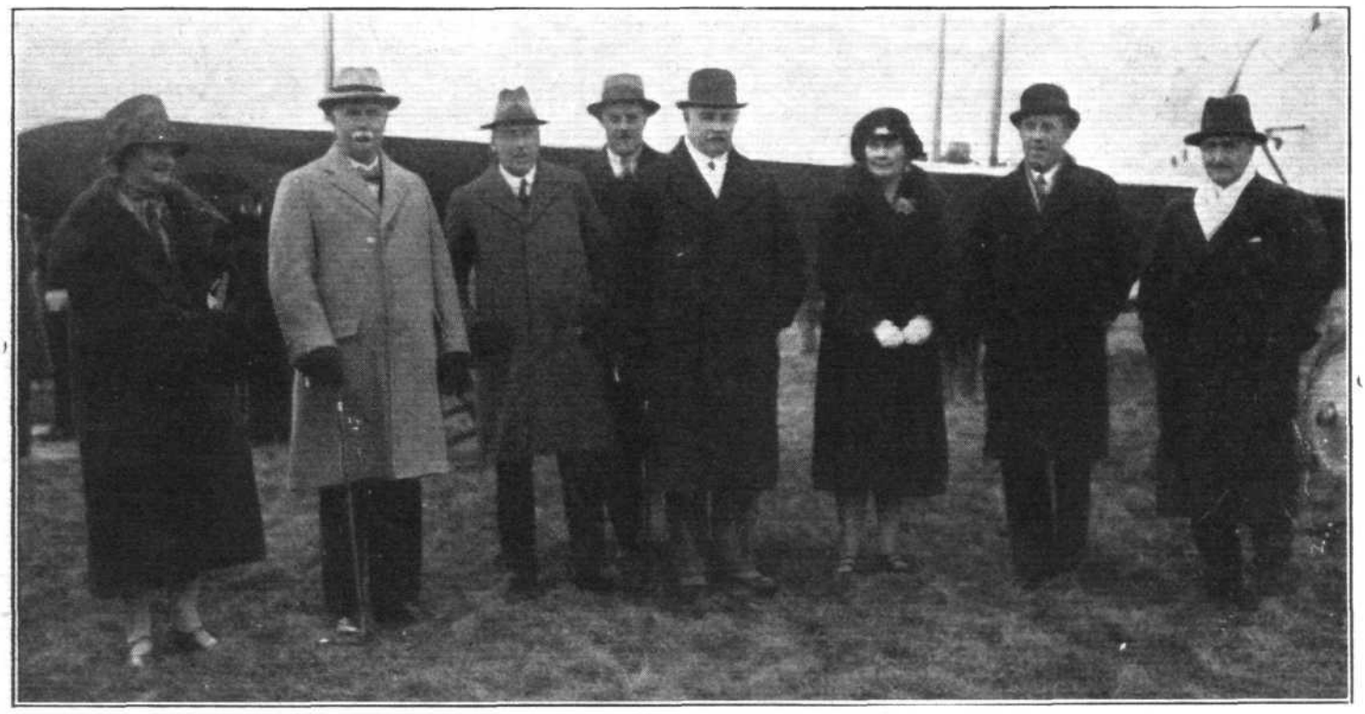
The new Westland limousine (three " Cirrus III " engines) was got ready in the meantime, and was then taken up by Mr. Paget, who had with him, as passengers, Lady Ryrie, Sir Sefton Brancker, Sir Ernest Petter and Mrs. Bruce. It was the maiden flight of the " Westland IV," and also the first flight of Lady Ryrie, who expressed herself delighted with the experience.

The rest of the afternoon was devoted to demonstration flights on " Widgeons," which proved very interesting, and it was noticeable how successful the new type of undercarriage is, "pancake" landings being made repeatedly without bouncing and without damage of any kind.

The Westland " Wapiti " has already been described and illustrated in FLIGHT (see issue of June 21, 1928), but a few

["FLIGHT" *Photograph*

ITS FIRST FLIGHT : The Westland " Wapiti " (Bristol " Jupiter VIII "), piloted by Capt. Paget, makes a flight immediately after the christening ceremony.



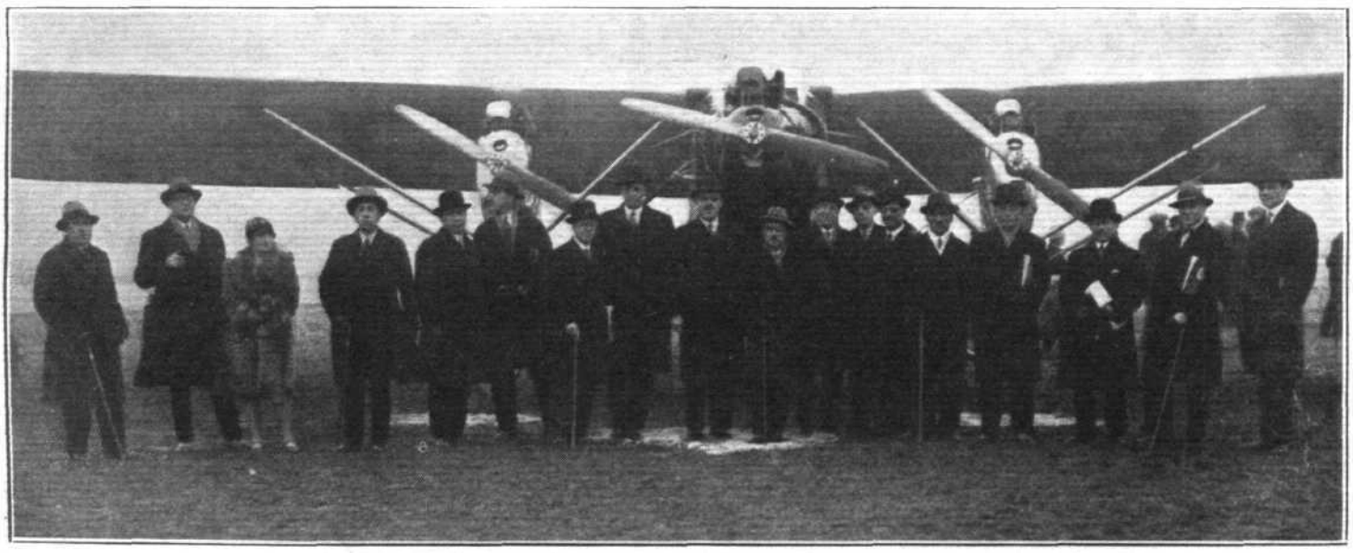
["FLIGHT" *Photograph*

GODFATHERS AND GODMOTHERS : This group, taken on the occasion of the christening of the first "Wapiti" for Australia by Lady Ryrie, includes from left to right : Mrs. Bruce, Mr. P. W. Petter, Mr. R. A. Bruce, Mr. Roy Fedden, Sir Ernest Petter, Lady Ryrie, Sir Sefton Brancker and Sir Stanley White.

notes on it here may be of convenience to readers. As already mentioned, the 28 machines ordered by Australia have wooden wings, whereas those delivered to the Royal Air Force have all-metal wings as well as all-metal fuselage. The "Wapiti" is a General Purposes aeroplane, and is fitted with the geared Bristol "Jupiter VIII" engine, which gives it a very excellent performance, as will be realised when we point out that at 5,000 ft. the speed is 142 m.p.h. (229 km.-hour). This speed figure relates to the machine fully loaded, *i.e.*, with a gross weight of 4,900 lbs. The service ceiling (*i.e.*, the height at which the rate of climb is 100 ft. per minute) is 24,200 ft., and the climb to 6,500 ft. only takes 6·4 mins.

The normal fuel tankage is 108 gallons, of which 68 gallons in the main tank in the fuselage and 40 gallons in a gravity tank under the deck fairing. This quantity of fuel is sufficient for a flight of half-an-hour at ground level plus 3¾ hours at 15,000 ft. A notable feature of the machine is that definite provision has been made for the stowage of the additional fuel and equipment necessary for desert patrol work, a feature which should be of importance in a country like Australia.

Handley Page automatic wing tip slots are a standard fitting on the "Wapiti," and have the effect of making the machine extremely difficult to spin. To get it into an accidental spin is almost outside the bounds of possibility. In connection with the automatic slots, it is interesting to note that the climb to 6,500 ft. referred to above is not affected in the slightest by the fitting of the slots, so that these cannot, even should they be partly open during the climb, add sensibly to the wing drag. In view of the fact that it is sometimes thought that the slots may affect adversely the performance of a machine, this fact is interesting.



["FLIGHT" *Photograph*

FOREIGN GUESTS AT A BRITISH CHRISTENING : Sir Sefton Brancker, Director of Civil Aviation, surrounded by Air Attaches, standing in front of the Westland IV monoplane.

Bigger plain type

FLIGHT

THE WESTLAND IV COMMERCIAL MONOPLANE

Three "Cirrus III" Engines

IT is now several years ago that FLIGHT suggested the advisability of producing three-engined commercial aircraft of low or medium power for use on air routes on which the volume of traffic is not such as to warrant the operation of three-engined machines as powerful as those now carrying out the work on the London-Paris and the Cairo-Baghdad air routes. That, power for power, or pay load for pay load, the three-engined type is not as efficient as the single-engined machine has to be admitted. But there are circumstances under which forced landings have to be avoided, and the three-engined machine capable of flying on any two of its engines provides a fairly short cut to this goal. Whether, by sacrificing a certain amount of weight in the engine itself and in its installation, etc., a single-engined machine could not be produced with as great a freedom from forced landings as the present popular three-engined type is another story, into which this is not the place to enter. There are still those who remain unconvinced that the three-engined type has necessarily come to stay. In the meantime, Imperial Airways, who possess more operational data than any other body in this country, are, practically speaking, concentrating on this type, and that being so, it is to be expected that the three-engined machine will have a long run of popularity even if it should not be found to be the ultimate type.

To the Westland Aircraft Works of Yeovil has fallen the honour of being the first British firm to produce a three-engined commercial aircraft of relatively low power. In fact, the Westland IV is probably the first machine of its power to incorporate the three-engined arrangement. The Handley Page "Hamlet," brought out some years ago, had three Bristol "Lucifer" engines of 120 h.p. each. The Westland IV has three "Cirrus III" engines of about 95 h.p. each (maximum).

General Design

The Westland IV is a high-wing monoplane with strut bracing, two outboard engines, a fairly large fuselage giving comfortable cabin accommodation, and an undercarriage of very wide track to give good stability on the ground. Features of the design are the neat engine cowlings and the "clean" tapering nose of the fuselage. The three-engined type must necessarily have a higher drag than the single-engined, but in the Westland IV it would appear that very great care has been taken to reduce the extra drag as far as possible. The central engine is carefully mounted and cowled, and the

["FLIGHT" *Photographs*

The Westland IV monoplane (3 "Cirrus III" engines) in flight. Above, on the right, Mr. Davenport, Westland's Chief Designer, and on the left Capt. Nevill Stack, of A.D.C. Aircraft, Ltd.

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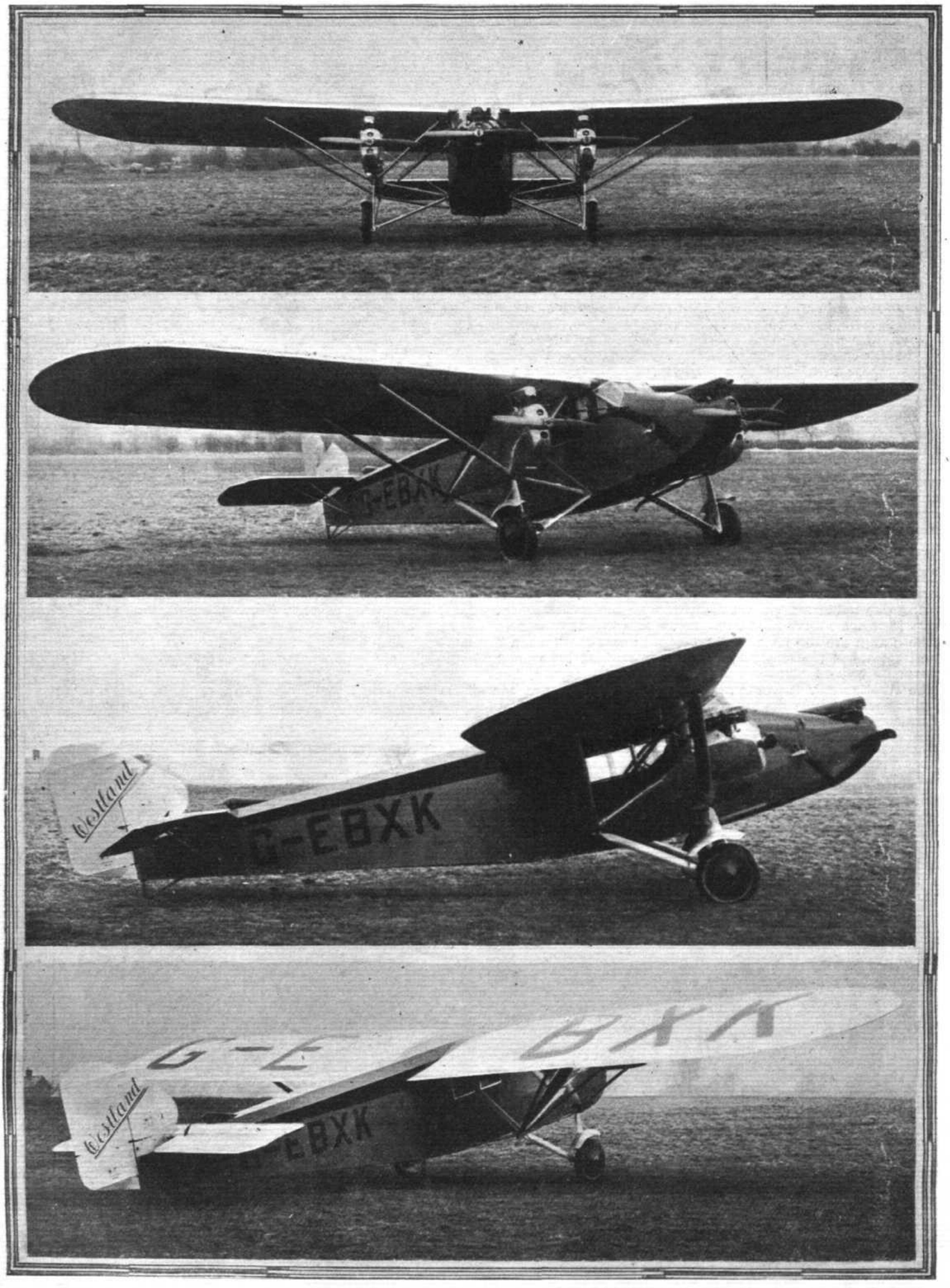
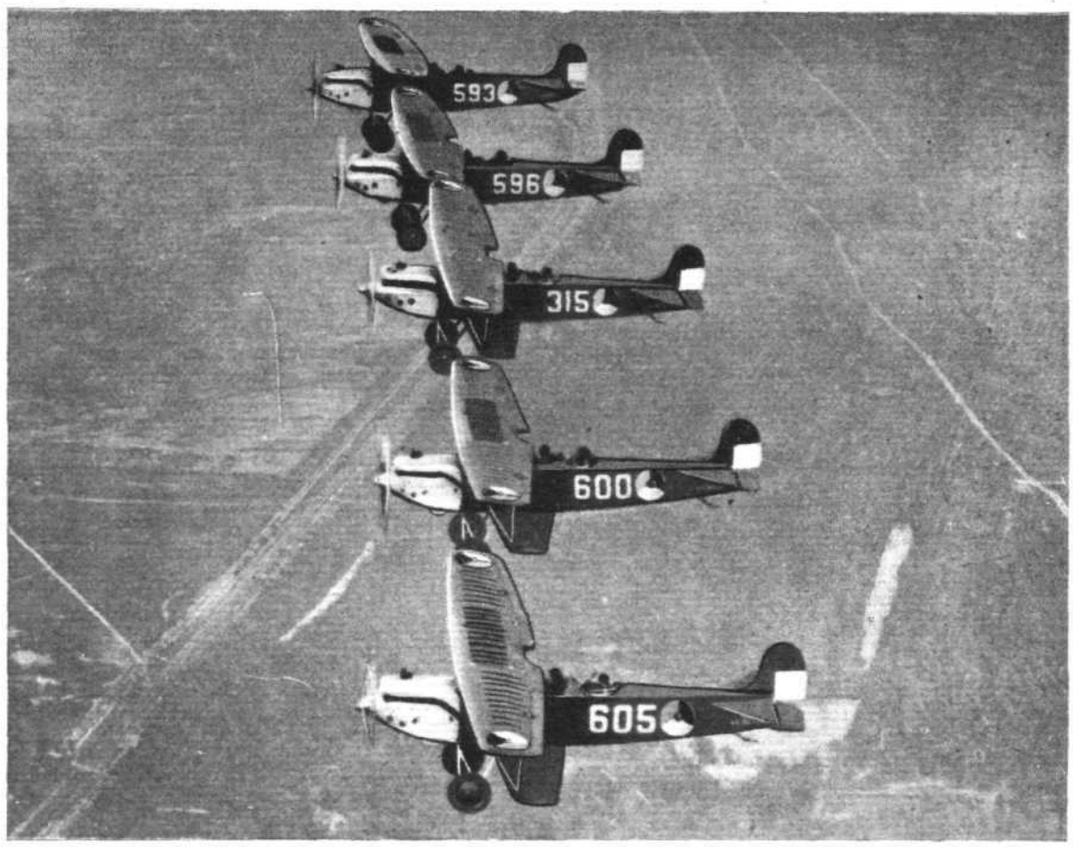


["FLIGHT" *Photographs*

THE WESTLAND IV COMMERCIAL MONOPLANE : These four views show the new Westland monoplane with three "Cirrus III" engines. The machine carries six occupants in a comfortable saloon.

DOPED WITH



The illustration shows a formation of Fokker C.V.D. Two Seater Fighters of the Royal Dutch Air Force.

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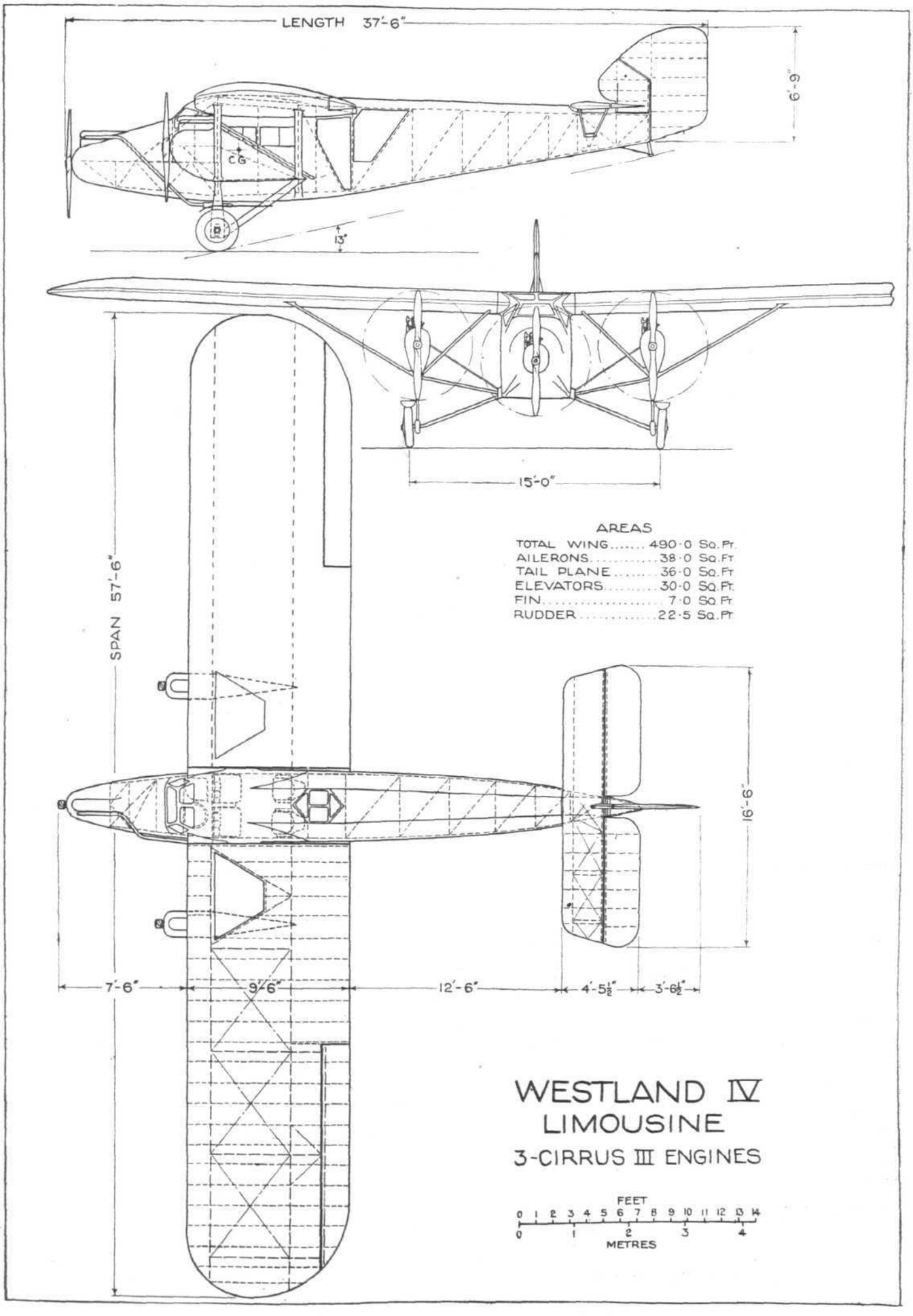

THE NEW WESTLAND IV THREE-ENGINED MONOPLANE : **General Arrangement Drawings.**

lines of the nose of the fuselage merge into the wind-screen, cabin, and wing without very abrupt changes of direction. The outboard engines are neatly cowled, the inverted pyramid mountings lending themselves to the production of cowls of smooth outline and without sharp corners, and which trail off to a point at the rear.

The wing section used is that known as R.A.F. 34, which has an almost stationary centre of pressure. The minimum profile drag coefficient is 0·0051 and occurs at a lift coefficient of about 0·1, both in British "absolute" units. The maximum lift coefficient is not high, about 0·51, at least according to model tests. There may, however, be a considerable scale effect, which may increase k_L max. to ·6. Based on model figures, and with a wing loading of 10 lbs./sq. ft., which represents full load, the stalling speed of the Westland IV should be 62 m.p.h. It is likely, however, that the full-scale lift will reduce this somewhat, and the actual stalling speed is probably in the neighbourhood of 55 m.p.h.

ment, especially in view of the experience which the Westland Aircraft Works have gained with metal construction.

The fuselage consists of the usual four longerons, but metal construction practice is followed in so far as wire bracing is not used. Vertical and diagonal struts are arranged in the form of an "N" girder, the joint between them and the longerons being by fishplates. In the forward or cabin portion three-ply wood is used as an internal lining, and also provides the diagonal bracing. The covering is of fabric throughout.

The wing structure is of orthodox design, with two main spars of wood, and wooden ribs. The ailerons, which are of fairly large span, are hinged to a false spar some distance behind the rear main spar. The covering is fabric, but the leading edge of the wing is covered, under the fabric, with three-ply so as to maintain the aerofoil form. It is noticeable that the wing covering fabric is exceptionally smooth and without sag between the ribs. Possibly the use

["FLIGHT" *Photograph*

THE WESTLAND IV : This photograph shows the engines, undercarriage and cockpit windscreen. Note the streamline engine housing and wide wheel track.

The total loaded weight of the machine is 4,900 lbs., and as the wing span is 57 ft. 6 in., the span loading, or $\frac{W}{\text{span}^2}$, is 1·485. Thus, at a take-off speed of 65 m.p.h., for instance, the horse-power required to overcome induced drag is only 57 T.HP. It would, therefore, seem that the wing arrangement chosen is a very efficient one. R.A.F. 34 section has a very good depth for spars, and its minimum profile drag is not much, if any, greater than that of R.A.F. 15. At a k_L of 0·46 the profile drag coefficient is 0·008, so that the profile drag at 65 m.p.h. would be about 85 lbs., corresponding to a T.HP. of 15 or so, giving a total T.HP. required for wing drag of about 52. This figure does not include the drag of the wing-bracing struts, as it is a little difficult to decide how many feet of struts are properly wing struts and how many support the wing engines. At any rate, the wing drag at speeds slightly above stalling speed is very low, and the wing design must be regarded as an efficient one, apart from any practical advantages which the high-wing monoplane machine may have.

Structural Features

The first machine is of composite construction, with wooden wing spars and ribs, and wooden fuselage construction, but it may be assumed that if the type should prove popular, which appears likely, an all-metal version is a logical develop-

of R.A.F. 34 section is partly responsible for this, as it has no concave curves.

The wing bracing is somewhat unusual, as has already been hinted at. Strictly speaking, the wing is braced on each side by but two relatively short struts springing from the points at the bottom of the engine mountings. But the engines themselves are not, as is more generally done, suspended directly from the wing. Rather must they be regarded as being carried from the apices of two prone triangles, the bases of which are in line with the fuselage sides. The inner ends of these two outriggers, as they may well be termed, are attached to lower longerons and wing centre-section respectively, so that the weight of the outboard engines is carried mainly from the fuselage, and only secondarily by the outer wing struts. The arrangement is unusual, and one which we do not remember having come across elsewhere. Structurally everything is triangulated, and each engine mounting is balanced, so to speak, upon a knife's edge, being steadied against torque-reaction by a single strut running to the lower longeron, and crossing the upper main supporting strut on its way. With the cowling removed, the outboard engines are extremely accessible, and a small hinged platform is provided on each engine mounting, on which the engineer can stand when making adjustments, and which are also useful for filling the wing tanks by hand.

HIP R.101.

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FLIGHT
AIRCRAFT ENGINEER AIRSHIPS

The Saloon

The cabin of the Westland IV is very roomy and comfortable, and seating accommodation is provided for four passengers, of whom two face forward and two aft. In front, and on the port side, is the pilot's seat, and to the right of him is another seat, which may be occupied by an engineer, or, if desired, by another passenger. Windows in the sides of the saloon give an excellent view, while as regards the pilot the sloping wind screen affords a good view forward. Aft of the cabin is the usual lavatory, the door arrangement of which is such that the lavatory space is made use of when entering and leaving the machine, but separated from the saloon when the machine is in flight. In the lavatory roof is an emergency exit.

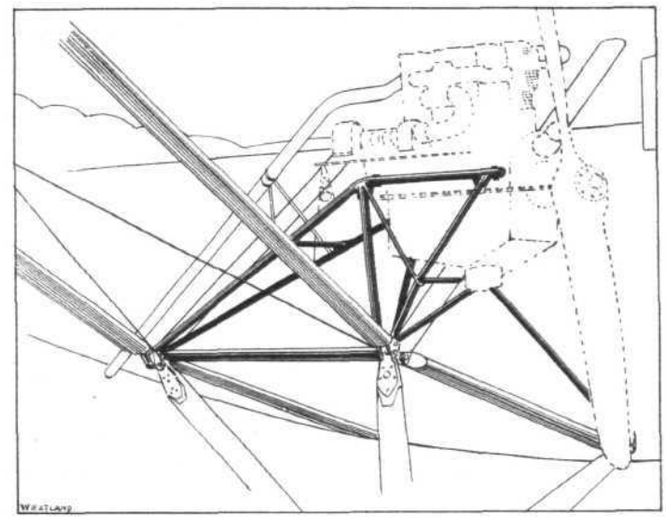
The saloon is entered through the aft door, and as the machine is quite low on the ground, passengers can step straight into the cabin by the use of very simple steps. Behind the saloon is a very large luggage compartment, and under the pilot's cockpit is another and smaller compartment for suitcases, &c.

The petrol tanks are housed in the wing, one of 48 gallons capacity on each side. From these two tanks the petrol flows by gravity to a common point, and thence to the outboard engines by gravity, and to the central engine by gravity, assisted by a windmill-driven petrol pump. In normal flying attitudes the "head" of petrol is sufficient to give gravity feed to the central engine also, but during a steep climb the pump is called upon to supplement gravity.

On the first machine the undercarriage consists of two simple vees, one on each side, under the engine mountings, and springing is by rubber shock absorbers. The next machine will, however, have oleo "legs," and wheel brakes. The wheel track is very wide (14 ft. 6 in.), and should give good stability on the ground.

During preliminary test flights one of the wing engines was stopped several times, and it was found that up to altitudes of about 5,000 ft. the machine could be flown, and even climbed slowly, on the two other engines. As the "Cirrus" is in itself an extremely reliable engine, a machine with three of them and capable of flying on any two should be to all intents and purposes immune from forced landings.

The first of the Westland IV limousine monoplanes has a tare weight of 3,145 lbs., and as its present C. of A. total gross weight is 4,900 lbs., the ratio of gross to tare weight is 1·58 to 1. With full tanks the cruising range is estimated to be 570 miles. The petrol (total capacity) would weigh approximately 700 lbs., so that, taking the weight of pilot as 160 lbs., and carrying no engineer, there would be available for pay load a capacity of about 895 lbs., which could be in the form of passengers or mails and goods. For shorter duration of flight, the pay load would, of course, be correspondingly increased. For instance, carrying 64 gallons of petrol, which would give a range of about 380 miles, and one pilot, the pay load would be approximately 1,120 lbs.



["FLIGHT" *Sketch*

THE WESTLAND IV MONOPLANE : Diagrammatic Perspective sketch, showing mounting of starboard wing engine.

Accurate performance figures have not yet been obtained, but the estimated cruising speed is about 95 m.p.h., and the estimated top speed 115 m.p.h. Assuming 90 b.h.p. as maximum power for the "Cirrus III," the power loading becomes $\frac{4,900}{270} = 18{\cdot}15$ lb./h.p. The wing loading is 10 lb./sq. ft.

With passengers' seats removed, a certain amount would be saved on the tare weight, and in that case the machine should be a very useful mail carrier, especially for the conveyance of night mails, where the reliability of the three-engined arrangement should make for safety. The stripped cabin and luggage compartments would then, between them, give an available cargo or mail space of 193 cub. ft. It would probably not be difficult, if desired, to arrange for a small extra supply of petrol, when the machine should be capable of the flight London-Berlin non-stop. We would suggest that an experimental night mail service between these two centres would be very well worth while.

For use in the dominions, the Westland IV should be an extremely serviceable type, and in this connection it might be pointed out that the machine could be fitted with floats and used as a seaplane. Presumably, it would also be quite feasible to fit it with a ski undercarriage for use in countries like Canada.

◈ ◈ ◈ ◈

Air Rescues from Kabul

THE R.A.F. Vickers "Victorias" and Handley Page "Hinaidi" continued their flights between Peshawar and Kabul carrying Europeans to safety from the threatened Afghan capital. Sir Francis Humphreys, the British Minister to Afghanistan, together with the remaining members of the British Legation, were flown safely to Peshawar on February 25. That completed the work of evacuation by the R.A.F. On that day seven Vickers "Victorias" and one Handley Page "Hinaidi" were engaged. There are still some German subjects at Kabul with the new German Minister, Baron von Plessen, who recently landed at the capital to take the place of the former Minister, who is ill at Peshawar. They did not avail themselves of the opportunity of evacuating the city in view of their contracts with the Afghan Government. His Majesty the King sent the following telegram to Sir Samuel Hoare :—"I heartily congratulate the Royal Air Force on the great feat of rescuing so many men, women, and children from Kabul in spite of the many difficulties in the air and on the ground.—GEORGE, R.I." Sir Samuel Hoare telegraphed the following reply to Craigwell House, Bognor :—"On behalf of the Air Council and Royal Air Force I desire to convey to your Majesty our deep appreciation of your gracious telegram of congratulations on the successful issue of the evacuation operations in Afghanistan. All ranks of the Force have been anxiously watching your Majesty's progress from day to day with earnest wishes for your speedy recovery. They will particularly welcome at the present juncture the consideration which has prompted you to send them so encouraging a message on the completion of a duty which they have been proud to perform in the interests of humanity." The King has also sent a telegram to Sir Francis Humphreys congratulating him on his safe arrival at Peshawar.

Too Thick

CAPTAIN MALCOLM CAMPBELL, who is in South Africa preparing for an attempt upon the motor speed record, was slightly injured in an air crash on February 25 when the machine, piloted by Mr. Penny, of Cape Town, hit a tree and was totally wrecked. Later he was flown to Cape Town by Major Miller, the South African airman, and on alighting at the Maitland aerodrome a strong gust of wind turned the light 'plane over. Capt. Campbell received injury to his face in the first crash at Calvinia and is suffering from slight shock. Mr. Penny suffered seriously from shock.

Long-Distance Record

THE numerous reports in the daily Press stating that the attempt upon the long-distance record by the R.A.F. Fairey monoplane (Napier "Lion" engine) will be made from Cranwell or Waddington in a few days' time are not authorised by the Air Ministry, who refuse to confirm or deny the truth of the reports. There is not likely to be any official notification of the start, so that the monoplane may be well on its way at any time now before the public hears of it.

EDDIES

THAT the first public message emanating from the King since his illness started, should be directed to the R.A.F., in praise of their successful and splendid rescue of men, women and children of all nations from Kabul, is a deserving compliment to our First Line of Defence.

WHY such a misleading description as "Flying Boat" Crash, without inverted commas, as applied by some papers in connection with the roundabout accident at Margate, in which one of the injured has just obtained £750 damages, should be indulged in, it is difficult to appreciate. As well now to indulge in the very much out-of-date phrase "I can no more do it than fly," or the wrongly used term of "motor accident" (instead of "traffic accident"), in which in at least 50 per cent. of cases the motor is a perfectly innocent participant. Fortunately this is now becoming recognised more generally, and it is time that roundabout machines should no longer be referred to as "flying boats."

WING-COMMANDER RODERIC HILL, M.C., A.F.C., probably one of the finest R.A.F. pilots in active work and practical air-research experiments, has given his experiences in connection with the pioneer work on the Great Eastern Air Mail Route, leading up to the establishment in about a month's time of the civilian Air Mail Route to India *via* Cairo and Baghdad, in an intensely interesting and fascinating book under the title of "The Baghdad Air Mail." Messrs. Edward Arnold & Co. are fortunate in having secured the publication of this valuable contribution to aviation literature, and from "advance information" we should say there will be quite a rush for the first edition due next week. The main contents cover a wide field, lightened with some twenty pages of illustrations and seven maps—ranging in its thirteen chapters from "The Making of the Air Mail Route" to the "Epilogue: My Departure from Iraq"—all for a matter of eighteen shillings. Wing-Commander Hill is not only a facile writer in recording facts, but is a brilliant artist, whose beautiful aviation drawings, which have appeared frequently in FLIGHT pages in the past, will no doubt be remembered by many. The publisher of FLIGHT will, upon application, be only too pleased to assist any readers to obtain copies of the first edition of this valuable work.

AGAIN aeroplanes to the rescue. In this case it is to help a party of British tourists stranded at Victoria Falls owing to a strike in connection with the Rhodesian Railway. Even motor-cars were of no use, apparently, and the "evacuation" arrangements had to rest upon aeroplanes.

BERT HINKLER the other day assisted at another record when flying at 3,000 ft. over Croydon in a Bristol Fighter, lent by the Aircraft Disposal Co., by picking up a special broadcast from Melbourne wireless station. The wireless operator was Mr. C. G. Allen, the well-known Belvedere amateur. Quite good reception was received. Our Bert is helping thus in making history in more ways than one.

"THE Spirit of Speed," a winged figure by Mrs. Harold Stabler, now being cast in gold to the value of £1,000 and presented by Sir Charles Wakefield to the Royal Automobile Club for the driver of the car to which is ascribed the highest speed officially, is indeed a fitting tribute to aviation, having regard to the fact that the age of winged flight has enabled man to surpass all previous speeds attained by the human race.

TANGANYIKA is one of the great important Colonial possessions of Britain that aviation will so materially assist in developing, and its great possibilities were particularly emphasised the other day by Sir Alan Cobham, when he spoke at a meeting of the East African Section of the London Chamber of Commerce, following a speech by Sir Donald Cameron, Governor and Commander-in-Chief of Tanganyika Territory. Sir Alan said Sir Donald had spoken of getting British capital into Tanganyika. He, Sir Alan, was working with the same object in view in attempting to establish an air service through the territory. The trouble in Africa was the great difficulty of transport. London business men did not have the time to visit countries like Tanganyika to examine projects for themselves. He hoped that it would be possible within 18 months for these men to leave London by a regular air service and to arrive in Tanganyika within seven days of their departure. The cost would be about 50 per cent. higher than the first-class fare by sea. He was grateful for the support Sir Donald had given to his scheme for an air service, and he hoped the British Government would also offer financial assistance.

WHAT an inhuman brute "Captain Arthur," who described himself as a "flying Ace," must be, in connection with his shameful hoax of 80 unemployed in the Northwood district last week. Without doubt he is a "flying" Ace, and for himself it were well so. Should he fall into the hands of a few of his victims he would have reason indeed for demonstrating that he is a "flyer." I only trust this heartless ruffian may *not* be able to fly from his just deserts. And apparently the whole shameful adventure appears to have been mainly for the purpose of getting a bogus cheque for £17 10*s.* cashed. In like manner to the past, when anybody shady would describe their occupation as "actor" or "actress," *now* it seems to be the fashion to hoist the pennant of aviation. The pity of it.

MORE Government enterprise. Earl Winterton has hopes, now the Rangoon racecourse owners have found it necessary, for certain reasons, to cancel permission for aircraft to alight on their racecourse, that when funds are available, the installation of a Government aerodrome may be contemplated. The noble Earl is quite optimistic, as he has even bracketed the 1929 Budget with his hopes.

THE erection of a tribute to America's greatness is being advocated by Mr. Paul Kroeger, a New York capitalist, in the form of a huge monument costing 11 million pounds sterling. It is planned to be the tallest tower in the world, 1,500 ft. high, capped with a light of 24 million candle-power, with a radius of 300 miles! Stupendous truly, but whatever other interests such an erection may serve, at least it should be a splendid beacon presently for Ocean flyers in their last lap.

WHAT a scramble it will be for finding "the better 'ole" presently, when the time comes—as for sure it will—for utilising against aerial bombing the underground shelters, which apparently are being planned and located in London. They will have to be some shelters, and when the alarm is sounded, it will be truly a case of the Devil taking the hindmost.

THE question which has arisen in Parliament regarding the pension of the Postmaster of Llanfairpwllgwyngillgogerchwyrndrobullllandysiliogogogoch, Anglesey, also suggests a possibility of a future aviation difficulty, from the fact that there are rumours, now that mention in the House has focussed attention on the town, that some enterprising Town Councillor is anxious to have an aerodrome installed there. The difficulty is, can a landing field be found big enough for blazoning the name on the ground, as is now the custom with all the leading aerodromes for the guidance of flyers? And again, how about a pilot wirelessing "I am going to land at, etc. In what direction is, etc.?" He would probably have got into the next county long before he had finished with the name. No wonder the Telegraph Department of the Government does not pay, if the name of this little village counts as a single word.

How curious are some of the coincidences that occur from day to day. In a very interesting résumé of his fifty years of the theatre which Mr. Ben Greet recently contributed to the *Observer*, Mr. Greet, in his reminiscences, refers to his return to London to the Old Vic the day after the outbreak of war in 1914, his stay there being until 1918. During this period twenty-four of Shakespeare's plays were revived, and "G.W.B.," who attaches his initials to the article, mentioned to Mr. Greet that he ("G. W. B.") was in the Old Vic on the first night of "King John." when enemy bombs were dropping round the theatre. Agnes Carter, who played Arthur, was only nine at the time, and she and Mr. Greet, who was Hubert, went through their scenes without turning a hair. The following day a shopkeeper in Waterloo Road complimented him on "gagging" so cleverly about "Austria's head," and Mr. Greet told him that the lines,

Some airy devil hovers in the sky,
And pours down mischief. Austria's head, lie there,
While Philip breathes,

were Shakespeare's.

German papers please copy.

AEOLUS.

The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

February 28, 1929

CONTENTS

EDITORIAL VIEWS.

It may be recollected that at the Berlin Aero Show last year, *Dornier Metallbauten* exhibited a small-scale model of a twin-engined racing seaplane. A sketch of this model was published in FLIGHT at the time, and it was pointed out that the Dornier firm did not propose to build the machine for the Schneider Trophy contest, unless financial assistance was forthcoming. The chief feature of the design was the use of two engines in tandem.

This month Mr. W. G. Carter, who, it will be remembered, was the designer of the "Crusader" racer with Bristol "Mercury" engine, looks into the subject of twin-engined machines for maximum speed. The "Crusader" was Mr. Carter's first effort in the way of a racing machine, and it was generally acknowledged to be an extremely good machine. One famous pilot who had flown it said that it was the sort of machine one would like to keep for a runabout if it were not for the cost; so that, for a high-speed machine it must have been very nice to fly. It came to grief at Venice through crashing, as a result of reversal of the aileron controls by a rigger.

Mr. Carter's suggested design differs from the Dornier in having a central boat hull, and should have the merit of keeping the spray off the propellers. How the lower wing would fare is, perhaps, a little doubtful. The view of the pilot is excellent, and the criticism that he is in a rather risky position in case of a crash may, perhaps, be met with the argument that in such a high-speed machine it matters little where the pilot is if a crash occurs. Mr. Carter does not suggest that the tandem engine arrangement is ideal, but suggests it as a means of getting a not inconsiderable speed increase with power plants already in existence.

From the earliest days of flying the question Monoplane, or Biplane? has been a vexed one. It still remains unsettled, and in view of its importance we are publishing a summary of Mr. Farren's paper before the R.Ae.S. on this subject. Mr. Farren is, as most of our readers probably know, lecturer in Aeronautics at Cambridge University, and in Aeroplane Structures at the Royal College of Science at South Kensington.

HIGH-SPEED SEAPLANES

By W. G. CARTER, M.B.E.

It is an interesting comparison to observe the rate of change of the speed characteristics of a number of seaplanes designed particularly for maximum speed, in relation to the thrust horse-power required in order to obtain this condition.

A curve (Fig. 1) has therefore been plotted to cover a period of six intervals, each of which, coinciding with the contest for the Schneider Trophy, is assumed to represent the culminating advance in engine design and aerodynamics. While this premise is subject to qualification, it is, nevertheless, of sufficient accuracy for the purpose of a general investigation. Similarly, average speeds are given over a comparatively long course, when maximum speeds over a short distance would have been more desirable. This limitation, however, may be offset by estimating a percentage increase of varying ratio, and a maximum speed curve has been plotted according to assumptions made in this respect. The progressive tendency of the velocity curve has been

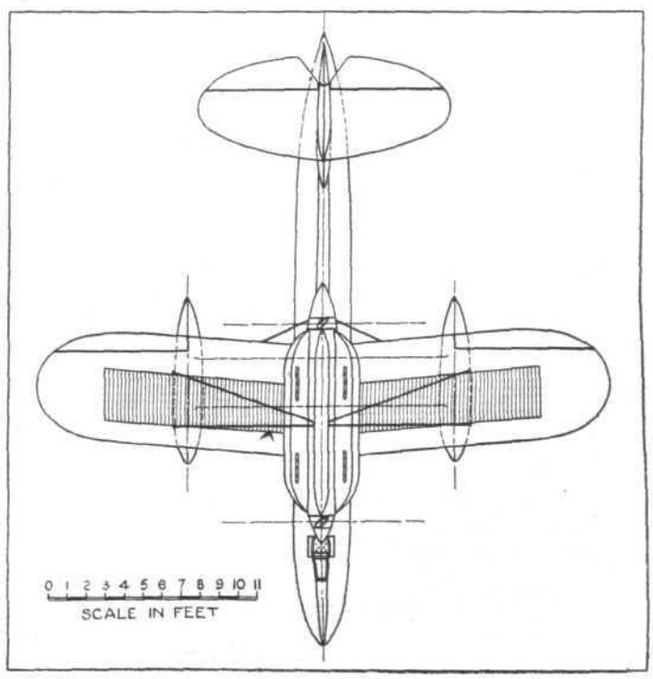


Fig. 2.

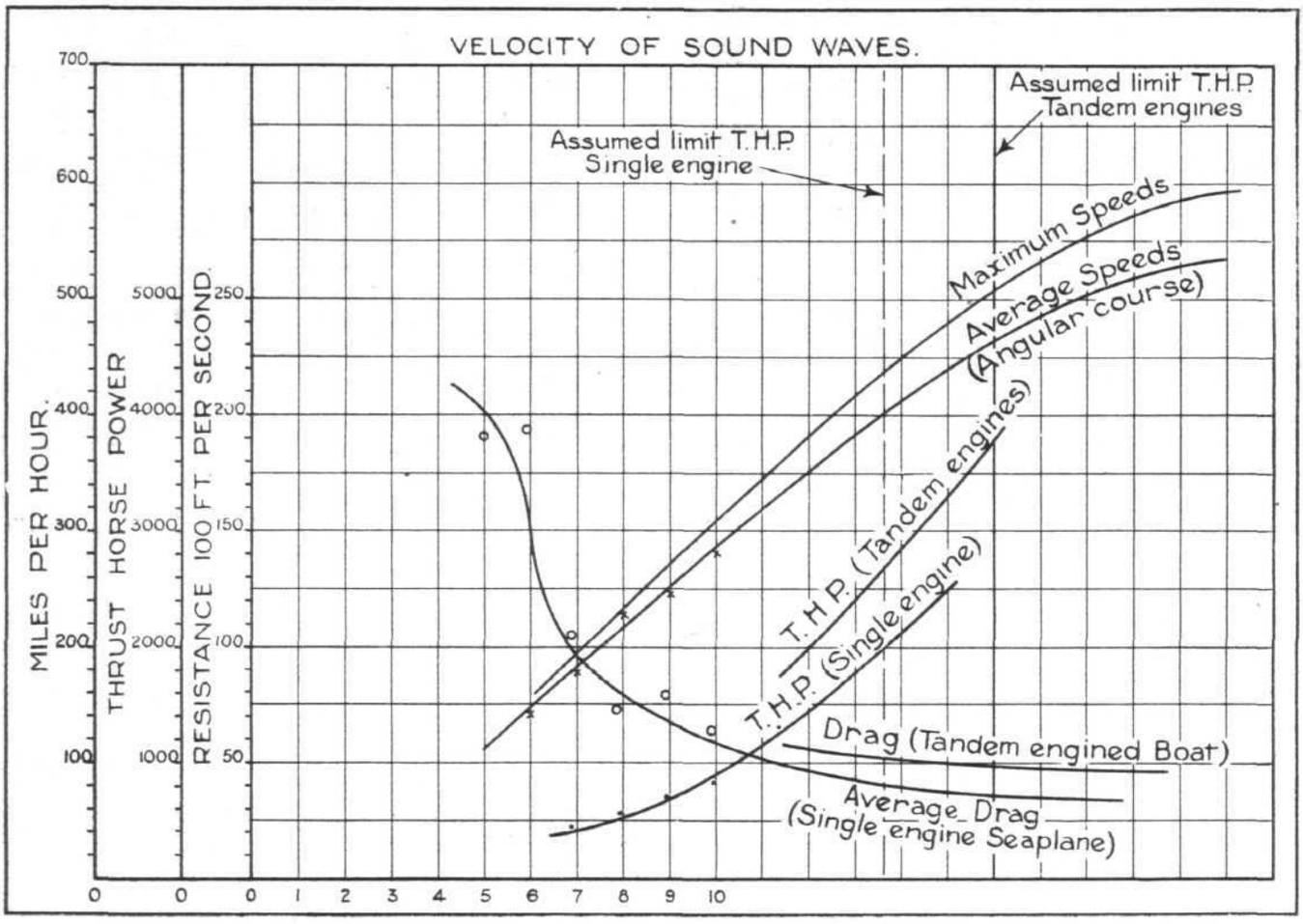


Fig. 1.

taken as sufficient justification to exterpolate to an assumed limit of 600 m.p.h. Around and beyond this figure certain fundamental conditions are modified in such a manner as to preclude the prospect of appreciable improvement in this direction. While one would hesitate to prescribe an arbitrary limit to the resources of research, invention and development, it has already been experimentally determined that the normal laws of resistance increase at a much higher rate as the velocity of sound waves is approached. An attempt, therefore, to advance to any extent beyond the region of the normal drag ratio would appear to introduce a condition where the gain would be insufficient compensation for the effort expended.

It is now proposed to review and summarise the progress that has been made up to the present time by an analysis of the performance of recent examples of high-speed machines, and to consider in what direction and to what extent future machines may be expected to materialise. The resistance of a modern twin-float racing seaplane at a velocity of 100 ft. per second may be assessed at a minimum figure of 45 lbs. for a monoplane and 49 lbs. for a biplane having the same engine installation. The individual drag of the various components, including their "interference effects," may be considered according to the following approximation :—

	Monoplane. Lbs.	Biplane. Lbs.
Main plane unit	14·5	15·5
Body	7·2	8·0
Tail unit	2·8	2·8
Two floats	8·2	8·2
Struts and wire bracing	12·3	14·5
Total	45·0	49·0

An average T.H.P. of 825 for each machine indicates that speeds of 317 and 309 m.p.h. should be obtained. Assuming that the present association of the various units is retained as a basis for future development, the following analysis of resistance at 100 ft. per second may be regarded as approaching the minimum ultimately obtainable by successive stages of refinement in design.

	Lbs.
Main plane unit	12·3
Body	5·5
Tail unit	2·2
Floats	7·2
Struts and wire bracing ...	7·8
Total	35·0

A reduction of nearly 23 per cent. from the present figure of 45 lbs. is therefore indicated, corresponding to a speed of 344 m.p.h., with the same available T.H.P. There appears to be little evidence, at the present time, to justify an assumption of any further appreciable reduction in resistance, and consequent improvement in speed, except in proportion to increased power output. A comparative limitation of this nature cannot, however, be applied to the possible development of the aircraft engine. The advent and successful application of supercharging, together with the continued advance in the manufacture of high-grade materials, affords considerable opportunity for increasing the output from the high standard already obtained. In comparison with specialised automobile practice, the brake horse-power per unit volume of the aircraft racing engine is considerably less than the best available per unit volume of racing car engines. As an example, the engine of one of the foremost racing cars in America is said to develop 143 b.h.p. for a capacity of 1½ litres. Admittedly the speed is high—6,500 r.p.m. The capacity of a typical engine for high-speed aircraft may be taken as 24 litres, and an average output at, say, 3,600 r.p.m. to be in the neighbourhood of 1,000 b.h.p. Assuming, for the moment, that the standard set by the "Miller" engine represents the comparative limit, *pro rata*,

of aircraft engine performance, we may anticipate the future advent of engines giving upwards of 2,000 b.h.p. without appreciably increasing their present capacity. On this basis, the power unit still provides the prospect and possibility of 100 per cent. development, compared with the figure of 23 per cent. in regard to aerodynamical improvement of the complete machine. The development of approximately 0·1 b.h.p. per cubic centimetre from engines of large capacity introduces problems requiring a great deal of experiment and research before a practicable compromise is likely to be in view. A possible avenue of design is the multi-crankshaft engine having the several shafts grouped about a central member carrying the gearing and airscrew. This arrangement will permit the inclusion of, say, eight banks of relatively small cylinders. The problem of cooling will be greatly simplified under these conditions, the superficial area of the cylinders increasing rapidly in proportion to the area, as the bore is reduced. This digression between the respective merits of engines of different capacity is intended to be of no more than a superficial nature in order to indicate the great advance that may be expected to mature at some future date. As such, it is submitted, with considerable reserve. Meanwhile, it is proposed to investigate the possibility of an immediate and substantial improvement in speed by installing engines already available into a machine somewhat dissimilar in type to the present series, which, apart from immaterial differences in the selection and disposition of the main plane surfaces have tended to become somewhat stereotyped. Among a number of alternative arrangements inviting some consideration, a selection has been made on the lines indicated by Fig. II, which gives the three-view general arrangement drawings. The installation of power units in tandem is suggested, and a reversion to the boat type of seaplane is considered desirable in order to accommodate the modified conditions to the best advantage. The biplane formation has been chosen on account of the constructional facilities permitted with this arrangement. The principal data in regard to this machine has, from preliminary calculations, been assessed according to the following approximation :—

Weight, fully loaded	5,500 lbs.
Area, main planes (total)	177 sq. ft.
Area, top plane	144 sq. ft.
Area, bottom plane	33 sq. ft.
Span, top plane	29 ft.
Span, bottom plane	12 ft.
Chord, top plane	5·75 ft.
Chord, bottom plane	2·75 ft.
Wing loading	31 lb./sq. ft.
Stalling speed	105 m.p.h.
Duration, full throttle	40 mins.
Range, full throttle	250 miles.

The constructional features of the racing boat provide certain advantages not easily associated with the twin-float seaplane. These may be summarised as follows :—

(1) The pilot is insulated from the general discomfort inseparable from accommodation immediately aft of the engine.

(2) The cockpit in the bow of the main float may be entirely enclosed without fear of the effects of exhaust gas and fumes accumulating.

(3) The pilot's view is much improved in all directions.

(4) The cross-sectional area of the engine nacelle may be reduced to the minimum required to fair the engine.

(5) Possibly more of the cylinder blocks may be left exposed with advantage to efficient cooling.

Offsetting these improvements is the large increase in total weight due to additional engine, fuel and structure, and to a lesser extent an appreciable increase in parasitic resistance. The former will occasion some sacrifice in manœuvrability, insufficient in degree, however, to affect seriously the average speed over an angular course. In regard to drag, a preliminary estimate has been made of the various units on the basis of 100 ft. per second, and the following total is submitted as an approximation subject to minor correction :—

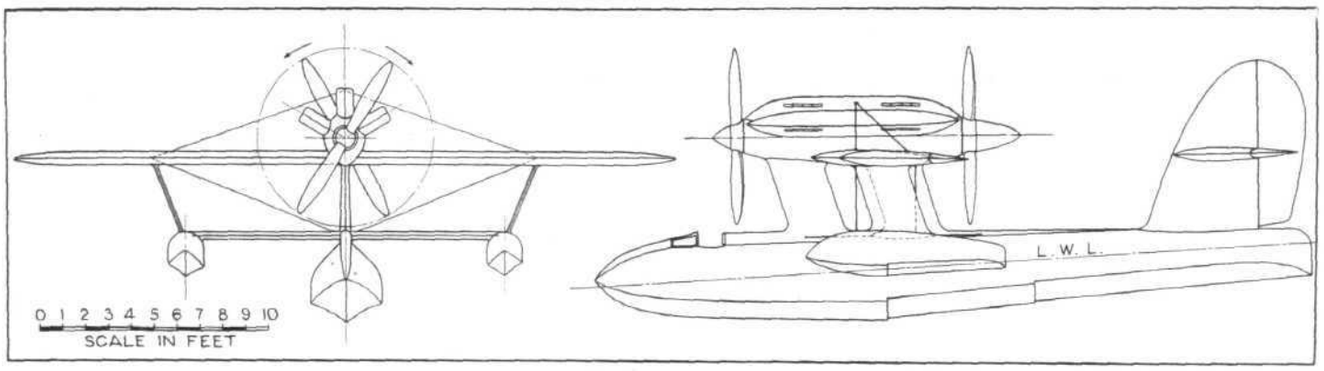


Fig. 3.

	lbs.
Top plane and engine nacelle	19·8
Lower planes and two outboard floats	8·7
Main float and tail unit	15·3
Struts and bracing wires	12·2
Total	56·0

To form a first comparison with the present type single-engined seaplane, and allowing for reduced efficiency of the tandem airscrews, a total thrust horse-power of 1,580 is considered available, giving a maximum speed of 365 m.p.h., or an improvement of 48 m.p.h. The principal constructional features of this flying-boat are as follows : The main float is constructed entirely in duralumin and the two main struts supporting the engine nacelle and top plane form an integral part of the boat structure. The struts are sufficiently substantial to accommodate stresses incidental to all conditions, excluding only those induced by torsional effects about their mean vertical axis. An approximate valuation in this respect indicates loads of a fairly high order, and to some extent indeterminate. Provision is, therefore, made by other and more direct methods to stabilise the wing structure. The engine mounting consists of an elongated triangular structure, carrying an upward extension between the two engines to provide a suitable attachment for the bracing wires over the top plane. The mounting is rigidly secured to the main struts and includes the necessary abutments for connecting the upper plane in position. In order to balance the machine without obstructing the rear airscrew it has been necessary to sweep back this plane to an appreciable extent. The lower planes emerge from the main float and terminate at the point of attachment of the outer stabilising floats. On account of the proximity of this plane to the water it is covered entirely in metal and is devoid of control surface. For a similar reason extension of span beyond the outer floats is considered undesirable. The system of bracing the main planes is somewhat unusual owing to the attachment of the auxiliary floats to the wing structure. It is essential that the upper plane

is sufficiently supported in order to withstand the severe torsional effects should the outer floats become operative to an unusual extent. The normal system of biplane bracing would be insufficient to provide the necessary degree of torsional rigidity in combination with a lower plane of such small dimensions. The upper plane has, therefore, been stabilised by the inclusion of bracing wires over the top surface, and the usual anti-lift wires between the two planes have been excluded as redundant. In order to relieve the lower plane and interplane struts of hydrostatic drag loads, bracing wires are attached to abutments on the main float, and terminate at the lower wing extremity. These wires are fitted fore and aft and in the same horizontal plane, and not easily seen in the front elevation. The tail unit calls for no more than general comment. The tail plane and elevators are carried by the fin which in turn forms an integral part of the boat structure. The aft part of the boat is sufficiently substantial to accommodate stresses induced by directional control and stability. The fuel tanks are suitably disposed immediately under the C.G. and on either side of the main strut root extensions. The assumed characteristics of this machine have been included in the diagram shown by Fig. 1, in order that an approximate comparison may be made of the respective merits of both types of seaplane.

LECTURES AND PAPERS

MONOPLANE OR BIPLANE? *

By W. S. FARREN, M.B.E., M.A., F.R.Ae.S., M.I.Ae.E.

This paper is an attempt to deal with the problem "Monoplane or Biplane?" with reference to the large commercial aeroplane of the future. I hope to be able to show that, if certain premises which appear to me to be reasonable are conceded, it is probable that for commercial aeroplanes of between 15,000 and 40,000 lbs. in total weight, the biplane arrangement which has been developed mainly in this country has on the whole the advantage. By a "commercial" aeroplane I mean one which may reasonably be expected to pay its way—to "fly by itself" financially. From a general survey of such real civil aviation as exists, I can see no early prospect of making such an aeroplane with a cruising speed exceeding 100 m.p.h., and I propose to consider the problem of "Monoplane or Biplane"? on this basis at first.

In one respect the solution of a purely commercial problem is in principle simple. We seek for the combination of characteristics which will produce the best return on the capital involved. Here we have a common factor in terms of which every proposal can be expressed—money.

The items of expenditure with which our problem is concerned may be divided into two classes. First, general commercial expenses:—

(1) Interest on first cost.
(2) Depreciation.
(3) Maintenance and repair.
(4) Insurance.
(5) Housing (as affected by size).

As to the first three I propose to say nothing, leaving it to those who are in a better position to judge to give their views. Insurance rates on certain British commercial aeroplanes are, I believe, lower than on any other aircraft—presumably because they are judged to be safer. I hope to show that they are safer to some extent because they are biplanes. As for housing, it will appear that a biplane is appreciably more compact than the equivalent monoplane.

The above items are difficult to assess mainly because a detailed analysis of the expenditure of Imperial Airways is not available.

Secondly, we have items of a more strictly technical nature:—

(6) Fuel consumption.
(7) Non-paying load.

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The problem under discussion is essentially one of engineering (*i.e.*, commercial and technical) compromise. No points of great scientific interest are in question and the most useful treatment is probably to consider in outline alternative machines (monoplane and biplane) to comply with some suitable specification.

Let us take as defined by reference to some agreed standards such as the I.C.A.N.

(1) the structural strength,
(2) the characteristics of stability and control,
(3) the take-off,
(4) the stalling speed,

and let us further agree to fix:

(5) the total weight of the machine,
(6) the engines, and their maximum and cruising rating,
(7) the range in air miles at cruising rating.

In virtue of having fixed (5) and (6), we may take the rate of climb at ground level as a measure of the take-off. Hence the total resistance under take-off conditions must not exceed a certain amount. Supposing that the resistance of the biplane under these conditions is such that the required rate of climb is attained, the lower parasite resistance of the monoplane makes it permissible to have a higher wing resistance (both profile and induced). It will appear that the structural problems associated with the monoplane are such that it is desirable to reduce its span, and therefore to increase its induced resistance, as much as the requirements permit. In what follows the adjustment of the proportions of the wings has been made on this basis. It results in the span of monoplane and biplane being practically the same.

Under cruising conditions induced resistance is relatively less important, so that in virtue of (6) the monoplane's cruising speed is higher by some 4 or 5 per cent. than the biplane's, and the fuel consumed for a given range is correspondingly less. The alternative—to reduce the cruising speed of the monoplane to the same level as that of the biplane by throttling the engine further—involves the difficulty of assessing the benefit to the engine's life and maintenance charges. This is avoided by the course adopted. The monoplane saves a definite amount of time and fuel, compared with the biplane, but in the other respects enumerated above (1) to (7) is essentially identical with it.

To arrive at equivalent dimensions for other essential parts, it is necessary to consider the problems involved in stability and control. Although there is some scope for difference of opinion on what particular combination of tail length, tail area, and rudder and fin area represents the best compromise the appropriate general characteristics are not in serious doubt, and the nett effect on the structure weight can be estimated closely enough for my purpose.

The final, and most difficult step in the technical comparison is to assess the structure weight of the monoplane and hence its paying load. When this is done there remain the commercial considerations enumerated in the third paragraph of this paper (1) to (5), but for reasons there stated I do not propose to deal with them. It may well be that they will prove to have more weight in the final decision between the alternatives than the technical points here considered. But to attempt to discuss them in the absence of a thorough exploration of the technical problems cannot lead to a sound conclusion.

As I happen to be familiar with its details, and as it is a type which apparently meets the requirements of Imperial Airways for certain services, I propose to take as an example the Argosy and to lay out the general proportions of equivalent monoplanes.

According to my estimate, based on the usual data, the resistance of the wing bracing of the Argosy may be expressed approximately in any one of the following ways:—

12 per cent. of the total resistance at cruising speed (90 m.p.h.);

21 per cent. of the parasite resistance of the whole machine;

57 per cent. of the profile resistance of the wings;

1·8 per cent. of the weight at 100 m.p.h.

THE AVRO TEN

A Three Engined Commercial Monoplane

The Avro Ten is a British version of the Fokker F.VII-3m., built under licence from the Fokker Company (N. V. Nederlandsche Vliegtuigenfabriek).

It carries eight passengers and is fitted with three 230 h.p. air-cooled Armstrong Siddeley Lynx engines.

Monoplanes of this type have attained a world-wide reputation for reliability, ease of maintenance and economy of running—qualities that have been proved during a period of several years.

They are used by the principal Dutch, Swiss and Italian Airlines.

Leading Features

ENDURANCE. 4 or 6 hours according to fuel capacity at a cruising speed of 96 m.p.h. with normal full load.

CONTROL. Complete dual control with side-by-side seating for pilots. Tail trimming gear allows large variation in the position of the centre of gravity.

CABIN. Dimensions 10′ ×5′ ×6′ with seats for eight passengers. Broad windows with wide angle views. Large door and direct access by fixed step.

BAGGAGE. Three compartments, total capacity 114 cubic feet.

FUSELAGE. Tubular steel with welded joints braced with steel struts and high tensile steel wire. Covered with fabric.

UNDERCARRIAGE. Special design of simple construction providing wide track. Rubber shock absorbers with special method of adjustment.

ENGINE MOUNTING. Of simple design permitting quick removal.

TANKS. Oil tanks fitted behind engines, fuel tanks fitted in wing providing simple gravity feed. Capacity with two tanks 150 gallons. With three tanks 225 gallons.

WING. Single unit of cantilever construction. Built of wood and covered with plywood to facilitate maintenance.

A. V. ROE & COMPANY, LIMITED

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Of this, approximately half is in the wires and struts themselves and half in end-fittings and "interference." I have examined a number of biplanes of similar size and I do not think there would be among them any material variation in the first two figures.

During the last three years biplane design has moved in the direction of lower profile resistance (by the use of wings with slightly higher maximum lifts): of lower general parasite resistance, particularly of bodies and engines; and of lower wing bracing resistance (by the use of fewer bays in conjunction with deeper wing sections). The net result is to leave the first two of the four figures given above very much as they were, but to reduce the last two to, say, 50 per cent. and 1·3 per cent. If we could eliminate the bulky end fittings associated with raf-wires, and reduce the "interference" by fairing, we could bring these two down to something of the order of 30 per cent. and 0·8 per cent. The problem of accessibility for maintenance is not one in which a competent designer should see insuperable difficulties. The last figures are in the nature of an irreducible minimum—the tax which a biplane pays for being a biplane. Most biplanes pay more.

loped by the Junkers J.13 does not exceed 0·55, and there seems no reason to expect a different result in the larger machines.

The second (B, Fig. 2) assumes $K_L = 0·55$ for the biplane and 0·70 for the monoplane, the latter figure being apparently characteristic of the Fokker (see R. & M. 1096), and that the profile drag coefficient is unchanged.

The third (C, Fig. 3) represents an intermediate (and possibly more rational) assumption, that the profile drag coefficient is proportional to the maximum lift coefficient. This leaves type C aerodynamically identical with A except that its chord is reduced in the ratio of 0·55 to 0·70 and certain alterations are possible in the tail length and areas.

Figs. 4 and 5 show corresponding views of the Junkers G.31 and the B.F.W. M.20 for comparison of general proportions.

The above comparison is based on the assumption that the parasite drag of the wing bracing of the biplane is entirely eliminated in the monoplane, but that in other respects their parasite resistances are the same. These are both favourable to the monoplane.

What we have done up to the present is fairly common-

TABLE I.—*Comparison of Biplane and Monoplanes*

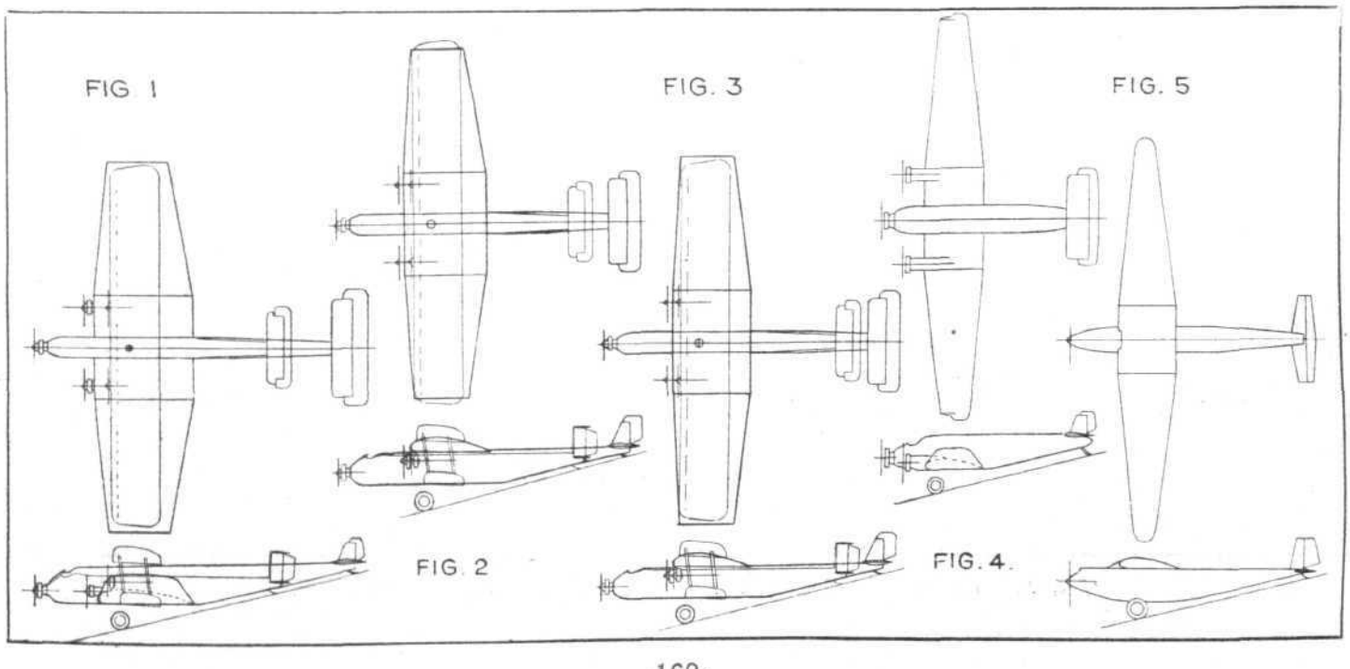
(Total weight 18,000 lbs.)

(i) *Dimensions etc.*

Type.	Biplane (Argosy).	Monoplane A.	Monoplane B.	Monoplane C.
Wing area	1900	1900	1500	1500
Max. K_L	0·55	0·55	0·70	0·70
Profile K_D	0·006	0·006	0·006	0·0076
Profile R_0/W	0·0313	0·0313	0·0249	0·0313
Parasite R_p/W at 100 m.p.h.	0·0830	0·0651	0·0651	0·0651
Induced R_i/W	0·0224	0·0280	0·0300	0·0280
Span B	89·5	91·0	87·5	91·0
Mean chord C	11·1	20·7	16·9	16·2
$r = l/C$	3·34	2·5	2·75	2·75
$a = S'/S$	0·114	0·129	0·112	0·108
Tail volume (ar)	0·380	0·323	0·309	0·297
Tail area S'	215	242	166	160
Rudder + fin area	118	86	96	102
Gain in cruising speed (per cent.)	—	3·9	5·1	3·9

Figs. 1, 2 and 3 show superposed, the outline of the Argosy and three equivalent monoplanes. The corresponding dimensions are given in Table I. The first (A, Fig. 1) assumes that the maximum lift coefficient is the same for both monoplane and biplane. We have evidence (Aeronautical Research Committee R. & M. 945) that the maximum lift coefficient deve-

place. In fact, I feel that every designer has probably been through something equivalent to it—designers are not so unintelligent as some of those who criticise their efforts would have us believe. In case anyone feels any qualms on the score of "aspect ratio" (for even to-day there appears to be some reluctance to recognise how greatly we are indebted



to Prof. Prandtl—and I think I ought to add Mr. Glauert—for clarifying our ideas on the economics of wing design) I may note that the adjustment of the proportions of the wings to give the appropriate induced resistance is precisely equivalent, in the language of ten years ago, to selecting the proper aspect ratio. I have no doubt that the aeroplanes shown in Figs. 1, 2 and 3 are comparable on the basis I have chosen—a fixed total weight, stalling speed, maximum brake horse-power, take off (measured by angle of climb), stability and control—and that the monoplanes will cruise at speeds of 4 to 5 per cent. higher than the biplane on the same fraction (approximately two-thirds) of the maximum brake horse-power. They will also require correspondingly less fuel for the same range in still air. But what of strength and structure as I shall show. Moreover, the monoplanes we think of have been developed under regulations which have either no corresponding requirement (as, I believe, in Holland), or a much less stringent one (as in Germany).

I propose to adopt our own regulations as a basis, but to discuss the influence of the terminal velocity dive separately.

Passing to the problem of the actual construction, we meet with the difficulty that we have very little experience of our own upon which we can base an estimate of structure weight. I have endeavoured to meet this by collecting information from designers and constructors in this and in other countries concerning the structure weight—in particular the weight of the wings—of monoplanes. I should like here to thank all those who have helped me in

TABLE II.

(i) *Monoplanes (with No External Bracing)*

Firm.	Type.	Total weight W lbs.	Wing area S sq. ft.	Span B ft.	Mean chord C ft.	Wing loading $w = W/S$	Span loading $\frac{w}{s} = W/B^2$	Load factor F	Wing weight $\div W = sw$	Source of data.	Remarks.
Junkers	J.13	3,900	372	48·0	8·2	10·5	1·7	6·9	0·15	Air Ministry	Include estimate for wing structure in body.
	G.24	14,300	1,050	98·0	10·0	13·6	1·49	5?	0·22	Makers	
	G.31	17,800	1,010	99·0	10·0	17·7	1·75	4·0	0·18	,,	
Rohrbach	Roland	16,300	940	85·0	11·0	17·3	2·25	—	—	—	Weights unobtainable.
	Rocco	23,000	1,010	85·0	11·9	22·9	3·18	—	—	—	
	Romar	41,800	1,820	121·0	16·0	23·0	2·86	—	—	—	
Beardmore	Inverness	13,300	756	90·0	8·65	17·6	1·64	4·0	0·205	Air Ministry	Includes estimate for wing structure in body.
,,	Inflexible	31,400	1,936	147·0	12·25	16·2	1·45	4·0	—	—	Weight unobtainable
B.F.W.	M.18	2,650	265	51·0	5·2	10·0	1·02	6·5	0·142	Makers	
	M.20	9,900	695	83·5	8·3	14·2	1·42	4·7	0·117	,,	
Focke-Wulf	Habicht	3,150	345	52·5	6·6	9·1	1·6	6·0	0·175	,,	Weights stated as "approximate."
	Moewe	8,400	670	65·5	10·2	12·4	1·96	5·0	0·157	,,	
Fokker	F.VII-3M	9,900	625	63·0	10·1	15·8	2·5	4·0	0·161	Messrs. A. V. Roe and Co., Ltd.	

(ii) *Monoplanes (with External Bracing)*

Firm.	Type.	Total weight W lbs.	Wing area S sq. ft.	Span B ft.	Mean chord C ft.	Wing loading $w = W/S$	Span loading $\frac{w}{s} = W/B^2$	Load factor F	Wing weight $\div W = sw$	Wt. of ext. bracing $\div$ wt. of wings	Source of data.	Remarks.
Dornier	A	1,480	166	32·0	5·2	8·9	1·45	5·4	0·160	0·17	—	From Dr. Dornier's paper, Journal R.Ae.S., December, 1928. Weights include struts.
	B	6,300	565	57·5	5·9	11·0	1·91	4·9	0·189	0·14	—	
	C	13,300	1,020	74·0	13·8	13·0	2·42	4·5	0·128	0·15	—	
	D	31,100	1,540	94·0	16·4	20·0	3·57	4·2	0·136	0·13	—	
	E	113,600	3,540	140?	25?	22·7	5·7?	4·0	0·145	0·11	—	
Vickers	Wibault	3,183	240	36·0	6·9	13·3	2·45	7·4	0·168	0·14	Makers	Weights include struts.
Westland	Wizard I	3,260	238	39·0	6·1	13·7	2·15	7·4	0·120	0·18	,,	
Hamilton	H.45	5,650	380	54·4	7·0	14·8	1·9	7·2	0·134	—	,,	Wing only (approx.).
Fairchild	F.C.2	3,600	290	44·0	7·0	12·4	1·86	7·5	0·150	—	,,	Weights include struts.
	F.C.W.2	5,500	332	50·0	7·0	16·6	2·20	7·5	0·119	—	,,	
Mahoney	Ryan Brougham	3,300	295	42·0	7·0	11·2	1·87	?	0·090	—	,,	Wing only.
Travel Air	6,000	4,100	282	48·5	6·5	14·5	1·75	6·4	0·130	—	,,	Weight includes struts.

weight? How are we going to make the monoplanes shown with no external bracing, and how much will they weigh?

We have here to take into account considerations which cannot be expressed with the same precision as we are able to attain with performance and other characteristics of the same nature.

We must first agree on a standard of strength. Taken generally, I think our regulations are reasonable, and I should be sorry to see them weakened. In one respect I think they are illogical—the requirement concerning the vertical dive at terminal velocity. It appears to me that this should find no place in regulations for civil aircraft of the size and type we are discussing. Whatever the general opinion on this may be, it is an undoubted fact that it is a requirement which reacts unfavourably on the monoplane, this way. I do not regard their action in this as entirely a personal matter, but rather as an expression of what I hold strongly to be the only sound view on the question of sharing of information in an industry. It was first pointed out, I believe, by Mr. North in THE AIRCRAFT ENGINEER, that if ten equally capable producers of similar articles share information of any type, each stands to gain nine times as much as he gives. I should personally be glad to see some advance by the S.B.A.C. on their present attitude.

When it comes to applying a similar principle to other countries, it is easy to see difficulties. It is, I think, remarkable that the principal foreign designers to whom I applied gave me what I wanted without reservation—an example of the advantages of conversations between individuals as a means of settling international problems.

I give in Table II the particulars I have collected.

The partially externally braced monoplane, so popular in the U.S.A. for small and medium-sized machines, must in the nature of the case be intermediate in characteristics between the internally braced monoplane and the biplane. We may expect to arrive at a clearer conclusion if we confine our attention to a comparison between the latter. Moreover, we have no information on the former type for large sizes except that contained in Dr. Dornier's paper. I have included this in Table II, which serves to bring out one point of interest—there is little difference, between the biplane and the externally braced monoplane, in the proportion of the total wing weight which is due to the external bracing. In regard to the low wing weights quoted by Dr. Dornier, these are all associated with so high a wing loading that it is difficult to make a fair comparison.

Of the internally braced monoplanes probably the most interesting are the Junkers and the Fokker. They present a remarkable contrast in material and in general technique. I doubt whether any lighter or more efficient schemes, using the material each prefers, could be devised.

The Junkers G.31 and G.24 set us one peculiar problem. Their respective total weights are 17,800 lbs. and 14,300 lbs., and their wings are identical, weighing 2,800 lbs. or 15·6 and 19·5 per cent. of their respective total weight. In such a design it is, I think, logical to add the weight of the "wing structure" passing through the body, which I estimate to bring the percentages up to 18 per cent. and 22 per cent. approximately. I can only presume that the G.24 was built to higher load factors than are now required, and that the strength of the wings was sufficient for an increased total weight. I believe I am correct in saying that for the G.31 a load factor of just under 4 is required, equivalent on the above assumptions to just under 5 for the G.24. The J.13, an older though essentially similar type, was tested at R.A.E. both structurally and aerodynamically. The wings weighed 12·7 per cent., which I propose to increase to 15 per cent. for the reason mentioned above. Their load factor at failure was 6·9, which probably indicates a design factor of 6.

The Fokker F.VII (three engines) has a wing in one complete unit, so that the wing weight (16·7 per cent.) is comparable with the Junkers figures as modified.

The Focke-Wulf "Moewe," a machine of which the Luft Hansa have a high opinion, is very similar in construction and weight to the Fokker. The weights and factors for the Moewe and the Habicht were given me by the makers, the former being marked "approximate."

The B.F.W. machines are as yet little known. They are distinguished by a relatively large span and the weights given are remarkably low.

For the Rohrbach machines and the Beardmore "Inflexible," I was unable to obtain weights. For the "Inverness," the data were obtained from the R.A.E. test, for which I have to thank the Air Ministry. The weight includes an estimate for the central part inside the fuselage.

It will probably be sufficient if we confine our attention to the Junkers and Fokker, representing two widely used types. To appreciate the significance of the figures given some discussion of the strength specification to which they are built must be attempted.

The German airworthiness regulations are in my opinion framed in a remarkably logical manner. Their basis is a factor of safety of 1·8 on load factors (for the "normal" class) of $n = 2 + 2/(W + 2)$, where W is the weight in metric tons, *i.e.*, for the G.31 a total of $1{\cdot}8 \times 2{\cdot}20 = 3{\cdot}96$. For the high speed condition the factor is approximately two-thirds of this. The terminal velocity dive is represented by the same attitude of flight (approximately zero lift) at a speed not greater than $2\sqrt{n}$ × the stalling speed, *i.e.*, 3 × the stalling speed, with the same factor of safety (1·8). Stalling speed is taken to correspond to ordinary wind tunnel data, giving probably about 0·7 for the maximum lift for the Junkers and hence a stalling speed for the G.31 of about 70 m.p.h. Taking the moment coefficient of the wings at zero lift to be −0·05, the corresponding tail load (including factor) is about one-third W. To comply with our airworthiness regulations more than twice this load would be required. I will take it that approximately the same conditions apply to the Fokker.

This considerable difference in tail load is reflected in a corresponding torque on the wing structure. Taking the weight of the aeroplane × the chord of the wing as a unit, my estimate of the torque (including factor) on the G.31 is 1·05. On our requirements it would be 2·25. It is difficult to assess its effect, but I think it would probably involve an increase of weight of about 10 per cent. In the Junkers this would take the form partly of a thickening of the covering, since this is the part of the structure mainly concerned with resisting torsional stresses. Probably some increase in the diagonal bracings would also be required, since these are responsible for distributing the air forces (which consist of fairly well localised upward and downward pressures over the rear and forward parts of the chord respectively).

The comparatively poor torsional strength and rigidity of any essentially laminar structure is a crucial difficulty in monoplane design, and the greater the torque in comparison with the maximum transverse loads, the more serious becomes the problem of coping with it. Even with aerofoils of a comparatively high thickness-chord ratio (0·15 and upwards) it is doubtful whether adequate torsional stiffness can be obtained except by use of a stiff covering for either the whole (Junkers and Fokker) or a part (Dornier and B.F.W.) of the wing. But for wing loadings of the order of 10 lbs./sq. ft. the large chord, in conjunction with a comparatively heavy covering,* would make the structure uneconomical, and we come to a high wing loading and a high maximum lift. The latter involves a large moment coefficient at zero lift, and hence a large travel of the centre of pressure in normal flight and a large torque on the wing in the terminal velocity dive.

The Junkers construction is a brilliant achievement, but it is economical only in conjunction with higher loadings, even in relation to the maximum lift that the model shows (which as I have mentioned does not appear to be attained on full scale), than we consider desirable from the point of view of safety, and a standard of torsional strength less than half that required by British airworthiness regulations.

The normal biplane is precisely the form of structure which has a natural torsional rigidity.

By the conventional method of calculating the strength of a biplane structure, in which certain bracing (incidence wires) is considered to be inoperative, we deliberately shut our eyes to this essential feature—torsional stiffness. I estimate that such a structure is some $2\frac{1}{2}$ times as stiff in torsion as is implied in our methods and generally appreciably stronger (though not in the same ratio). This high torsional stiffness has an influence which may be important and will in all practical cases be helpful on the distribution of loads in the members of the structure, whatever the nature of the load may be.

For the monoplane such considerations are vital, and in so far as we recognise them in monoplane and not in biplane design we are unreasonably handicapping the biplane.

Even with this handicap the biplane appears to be lighter than the equivalent monoplane. In estimating the weight of the latter from the information we have accumulated we have to take into account the following factors :—

(1) For the wings, the large chord, involving thicker covering or more internal bracing, or both ;
(2) For the rest, the extra length of body (involving also extra depth) and the change in tail surfaces ; and
(3) For both, the increase in strength required to cope with the terminal velocity dive.

In Table III I give my estimates for the three monoplanes of Figs. 1, 2, and 3. We start from the known weight distribution of the biplane. I think I am justified in treating the one selected as typical of biplane design of its date. There is evidence that the structure weight of modern biplanes, whether of composite or all-metal construction, can be reduced appreciably below the figures taken. We shall therefore run no risk of taking an excessively optimistic attitude towards the biplane. For the monoplanes, the

* On the Junkers J.13 the covering, including longitudinal stiffening strips, weighs between 0·7 and 0·4 lbs. per sq. ft. of double surface.

TABLE III.

Comparison of Biplane and Monoplanes.

(ii) *Percentage Weights.*

Type.	Biplane.	Mono-plane A.	Mono-plane B.	Mono-plane C.
Power plant ..	15·7	15·7	15·7	15·7
Fuel + tanks ..	13·7	13·2	13·0	13·2
Wings	18·0	24·0	22·0	21·5
Rest of structure ..	18·1	23·0	21·0	21·5
Disposable ..	34·5	24·1	28·3	28·1
Crew + equipment	4·4	4·4	4·4	4·4
Passengers + luggage	25·3	16·6	20·1	19·9
Equipment ..	4·8	3·1	3·8	3·8
Lbs./b.h.p. ..	16·0	16·0	16·0	16·0
B.h.p./passenger ..	55·0	83·0	69·0	69·0
With fuel for double range.				
Disposable ..	20·8	10·9	15·3	14·9
Passengers + luggage	13·8	5·5	9·2	8·8
Diagrams	—	Fig. 1	Fig. 2	Fig. 3

TABLE IV.

A Commercial Aeroplane to Cruise at 150 m.p.h.

Type.	Biplane.	Mono-plane.	Remarks.
Weight ..	28,000	28,000	
Wing area S	2,300	2,000	Assuming biplane K_L 0·6, monoplane K_L 0·7.
Profile R/W	0·025	0·025	
Parasite R_p/W	0·030	0·022	Difference due to wing bracing
Induced R_i/W	0·030	0·034	
Lbs. per b.h.p. cruising	13·9	15·8	Assuming η=0·85, f=0·9.
Lbs. per b.h.p. maximum	10·4	11·9	Cruising at three-quarters max. b.h.p.
Span B ..	96·0	102·0	
Chord C ..	12·0	19·5	
Percentage weights.			
Power plant..	24·0	21·0	In ratio of max. powers.
Fuel and tanks	16·0	14·0	,, ,,
Wings ..	18·0	22·0	Estimated as explained in text.
Rest of structure	18·0	21·0	
Disposable ..	24·0	18·0	
Crew + equipment	4·0	4·0	
Passengers + luggage	16·0	14·4	
Equipment ..	4·0	3·6	
Horse - power per passenger	123·0	120·0	

weight of the engine, etc., remains unchanged, and that of the fuel and tanks is reduced in inverse proportion to their cruising speeds. The wing structure weight I have estimated from the actual weight of the G.31 and F.VII given above, allowing for the factors just mentioned. The weight of the rest of the structure is derived in a similar way, using the weights of the appropriate details on the biplane as a guide.

If these figures are accepted, it appears that the first monoplane (A) is handicapped by its large wing surface, corresponding to the assumption of the same maximum lift coefficient as the biplane (0·55). It is important to notice, however, that our full-scale evidence on the J.13 suggests that this applies to the Junkers wing. The paying load is reduced to 65 per cent. of that of the biplane, and the cruising speed rises 4 per cent.

Monoplanes B and C are in a much better case, carrying 79 and 78 per cent. of the paying load of the biplane, with cruising speeds 5 per cent. and 4 per cent. higher. I think C is more representative than B, the assumption of a profile drag coefficient for the latter equal to that of the biplane being unduly optimistic.

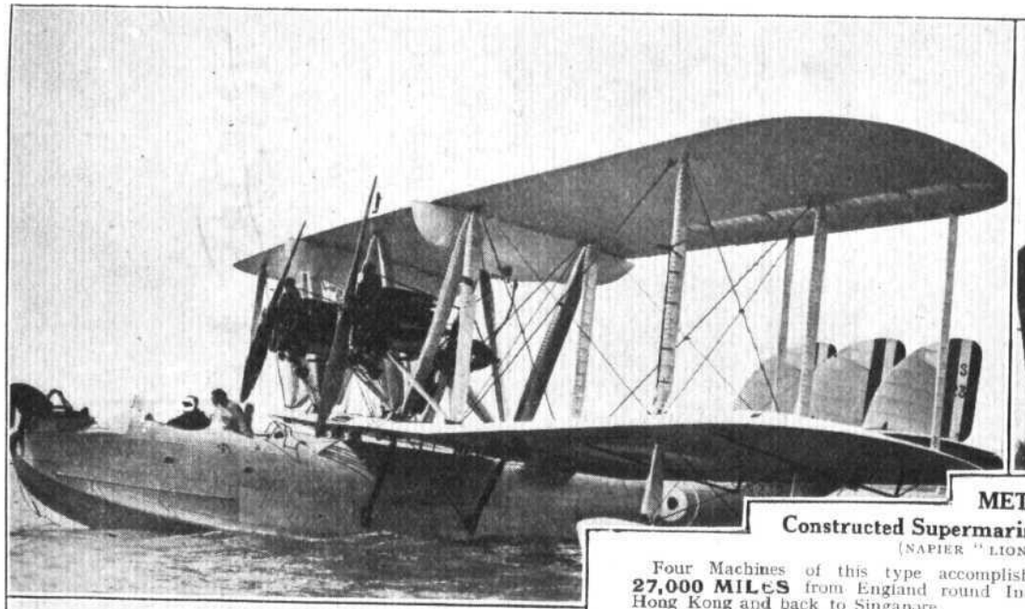
These figures all refer to aeroplanes with a comparatively moderate range. If we double the fuel carried, the paying load of the biplane is reduced by 45 per cent. and the *relative* paying loads become: biplane, 100; monoplanes A, 40, B, 67, C, 64.

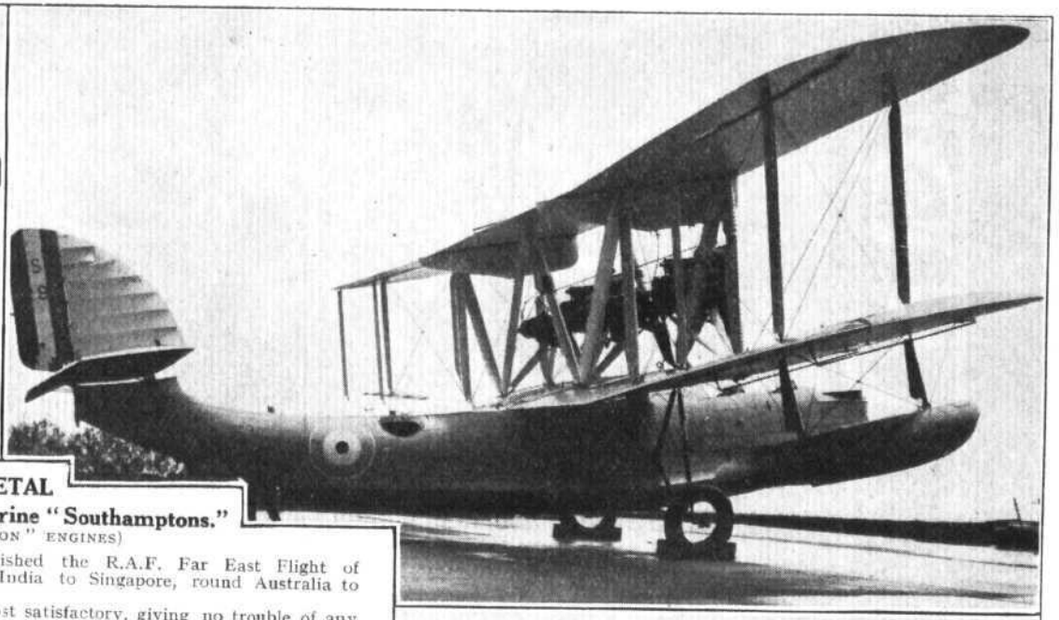
In all cases allowance has been made in the fuel for the increase of cruising speeds of the monoplanes at the same engine power, and for a reduction in cabin furnishing, etc., in proportion to the number of passengers. The latter allowance is somewhat too generous, an appreciable part being independent of the number of passengers.

In summary, we must expect to lose some 20 per cent. of the paying load of a machine of the type I have taken to represent present-day commercial biplanes, if we transform it into a monoplane. This loss will increase as the range increases. We may expect a rise of 4 per cent. in the cruising speed, and an equal reduction in fuel consumption (for a given range). The loss is due to the need for preserving our standards of safety. I propose to leave to those who have the necessary experience the task of deciding whether in the other respects which I mentioned at the beginning of this lecture the monoplane or the biplane is to be preferred.

In what way may we anticipate that the position is likely to change in the near future? The developments I can foresee at the moment appear to me to contain equal possibilities for both monoplane and biplane, with one exception. If for some reason—it must be a good one—the permissible stalling speed were materially raised, say, to 65 or 70 m.p.h., the monoplane would gain more than the biplane, for their relative spans would remain much as I have indicated, and a reduction in chord beyond a certain point is uneconomical for the biplane unless satisfactory wing sections of still greater thickness-chord ratio can be devised. But I confess I do not think such a rise in stalling speed is justifiable. Adequate control above the stall may permit of a slight rise, but so far this has not been achieved with wing sections of the types that are essential to monoplane design. The case of the admittedly good control of the Fokker machines at low speeds may be advanced, but such evidence as I have seen on this suggests that it refers really to speeds above the stall, which is virtually equivalent to reducing the effective maximum lift coefficient. There does, in fact, seem to be something in the nature of a real bar to effective maximum lift coefficients greater than about 0·6—and we can reach that on a biplane.

I said at the beginning of this lecture that I proposed to consider only *commercial* aeroplanes, and I interpreted that as limiting the cruising speed to something less than 100 m.p.h. For this speed we provide at present about 60 b.h.p. (on the full rating of the engine) per passenger and use about 40. What can we do to raise the cruising speed, apart from providing more power (which is precisely what will make civil aviation uncommercial)? Only by reducing the parasite resistance to about one-half its present amount can we contemplate a commercial aeroplane cruising at 150 m.p.h. In Table IV I give a suggestion for the chief proportions of such an aeroplane of moderate range as a monoplane and as a biplane. The take-off disappears as a criterion, being for both much in excess of present standards, and the monoplane can reap the full benefit of its lower resistance, requiring some 13 per cent. less power and less fuel. I have assumed that we can succeed in reducing the bracing resistance of the biplane to 30 per cent. of the profile drag of the wing, as suggested earlier—an easy task in comparison with that of reducing the other parasite resistance. I estimate the gross paying load of the monoplane to be about nine-tenths of that of the biplane. About 120 b.h.p. per passenger will be required, about 90 being used at cruising speed. I think the monoplane has now a slight advantage. We have a long way to go before we can reach this stage. We must become more prosperous—for we shall have to pay for our 120 h.p. We must learn also how to reduce the resistance. Probably by then we shall have learnt how to make still better biplanes.





METAL

Constructed Supermarine "Southamptons."

(NAPIER "LION" ENGINES)

Four Machines of this type accomplished the R.A.F. Far East Flight of **27,000 MILES** from England round India to Singapore, round Australia to Hong Kong and back to Singapore.

"The aircraft and engines have been most satisfactory, giving no trouble of any consequence, no forced landings, and only very minor replacements being necessary; the water-tightness of the metal hulls and floats has been excellent.

"Three of the aircraft will be used for the next cruise, the fourth will remain at Singapore in accordance with Air Ministry instructions."

Extract from Official Log, 15-1-29.

SOUTHAMPTONS designed and constructed by

THE

SUPERMARINE AVIATION WORKS, Ltd.

Proprietors:—Vickers (Aviation) Ltd.

SOUTHAMPTON, ENG.

FLIGHT

PRIVATE  FLYING

A Section of FLIGHT in the Interests of the Private Owner, Owner-Pilot, and Club Member

ANNUAL DINNER OF THE NORFOLK AND NORWICH AERO CLUB

THE Norfolk and Norwich Aero Club held its annual dinner at Norwich on February 22, with Air Vice-Marshal Sir Sefton Brancker as principal guest. The Chairman was Captain A. A. Rice, who explained the unavoidable absence of the Hon. Lady Bailey, the Lord Mayor, Sir Edward Stracey, Captain Cator and Mr. C. R. Bignold. In the absence of Captain Cator, the toast of the "Kindred Clubs" was proposed by Mr. J. D. North, chief designer of Messrs. Boulton and Paul, Ltd., of Norwich. Mr. North expressed pleasure at seeing the representative of another club present, because he remembered how splendidly other clubs rallied round them when they held their inaugural flying meeting. They came on their machines from long distances in adverse weather, and all of them started in aeroplanes, although some of them got there in motor cars. That was a tangible sign of the good fellowship which existed between the aero clubs of this country, and he was impressed with the spirit shown at that meeting. Most of the clubs were now reaching a stable position after a difficult start. It was not for him to say whether they were reaching that position by reason of being subsidised or not. Some of them were reaching it without a subsidy. The Norfolk and Norwich Club could only congratulate them and hoped sooner or later to follow in their footsteps.

All clubs were looking forward to the day when they were going to get on a self-supporting basis. As to the scheme which was being put forward for National Flying Services, it appeared to be the subject of acrimonious debate in the House of Commons, but he thought everybody ought to take a very wide outlook in considering what National Flying Services, Ltd., proposed to do. One gentleman had told him that the shareholders were going to be philanthropists and the underwriters martyrs. Any proposal, however, that tended to increase flying facilities in this country in the future could not fail to be of benefit to the country generally. He had no doubt that a good deal of the enthusiasm, and the work put into the clubs was due to the fact that they were organised on a territorial basis, an advantage he thought that would not be lost sight of. Most of them were spreading out their activities as the Norfolk and Norwich Club was, towards Yarmouth and Cromer, and forming a network through which they would come into contact with one another. The Norfolk and Norwich Club always watched with sympathetic interest and every goodwill the progress of all other clubs in this country.

Dr. Sleigh (Suffolk Light Aeroplane Club), in reply, said the chief point which Mr. North had mentioned must be in the minds of all flying clubs. People had criticised the Guest scheme in many ways. They said it could not possibly succeed and pay a dividend on the sum of money proposed to be raised. But he thought that might be left to the able men at the head of the scheme. He would ask everyone to consider carefully before going into definite opposition to it.

The Chairman, calling upon Squadron-Leader "Bert" Hinkler to propose the next toast, spoke in complimentary terms of the historic flight Mr. Hinkler had made from England to Australia twelve months ago. The Norfolk and Norwich had reason to be interested in and proud of that flight, because Mr. Hinkler had helped them to form that club.

Sqdn.-Ldr. Hinkler then proposed the toast of the Norfolk and Norwich Aero Club, remarking that it was a very happy coincidence that twelve months to that very day was a great day for him, and made him feel that the proceedings that evening were even greater than might be supposed. The club movement, he considered, was a very important factor in popularising flying. It was unfortunate that aviation was a somewhat expensive luxury but before very long it would become a necessity.

Capt. A. A. Rice, responding to the toast, said that the membership of the club had grown from 50 to 376, of whom 140 were active members and 79 had undergone instruction. Speaking of the Guest scheme, Capt. Rice said frankly that the Norfolk and Norwich Aero Club was not hostile to any scheme which promised to promote aviation. They naturally, however, felt a little anxious regarding their own position. The club had been built up by hard work. He hoped that whatever schemes were proposed by any Government would regard favourably the successful club.

Capt. R. T. Harmer, who also replied to the toast, observed that the Guest scheme proposed to have aerodromes at all convenient centres, which would enable people who wanted to fly to use them as a means of transport. The fact that subsidiary aerodromes were desirable was what the Norfolk and Norwich Aero Club had considered, and they could form branch aerodromes in towns in Norfolk like Yarmouth, Cromer and King's Lynn, which, if that could be done, would very much strengthen the Norfolk and Norwich Club.

The health of "The Visitors" was proposed by Capt. Dawson Paul. He said that he himself was a comparative newcomer to the world of aviation, but practical interest in aeronautics was a tradition in his family, insomuch as between 1846 and 1847 his grandfather used to venture forth with the aeronaut Greene to taste the joys of aerial travel in a free balloon. How much more easily, how much more cheaply, and with how much less risk was it now possible for us to experience the pleasure of flying by virtue of the opportunities that the flying clubs afford us! Out of the limited sums which were actually available for civil aviation, there was probably no item of expenditure for which the country had received greater value than the subsidies of light aeroplane clubs, to which had been added the support, financial and personal, both of private individuals and those who were engaged in the aircraft industry, and to this had also been added the generous assistance and practical sympathy of those interested in aviation in other parts of the country.

Sir Sefton Brancker said that this was going to be a vintage year in aviation, he hoped. A leading firm of Norwich had produced an airship which, he believed, would prove well ahead of the world in respect of airship design. Mentioning the Guest scheme, he said that the air clubs had begun extraordinarily well. He believed the Norfolk and Norwich Club was third on the list in respect of membership, and altogether first on the list in respect of the number of people under instruction. The Guest scheme could not do anybody any harm. He hoped it was going to reduce the price of light aircraft, and give us many more places to fly in. When a club came to the end of its tether, with regard to financial assistance from the Government, it could do what it liked.

There was no reason why it should join the Guest scheme. "If you find you are on a proper financial basis, and can go on with your individuality and remain an individual unit, as the Norfolk and Norwich Aero Club is, you will have our blessing, and our hope for your prosperity in the future." He did not think anyone need worry about the scheme. Generally speaking, he thought it would have an exhilarating effect.

Sir Sefton added that he did not know whether the municipality of Norwich was considering the question of an air port, but at all events Norwich had one of the best aerodromes in the country. Mousehold would make a good aerodrome if some agreement could be come to with the War Office, the War Office being easier to come to an agreement with than the Air Ministry.

WESTLAND "WIDGEON" (GENET) AIR TOUR TO NORTH AFRICA

4,200 Miles in 60 Hrs. 50 Mins. Flying Time

AN air tour from England to North Africa and back was recently completed by Mr. "Harold Brooklyn" and his wife in his Westland "Widgeon III" monoplane fitted with an Armstrong-Siddeley "Genet" engine.

Incidentally he has turned his machine into a semi-cabin type by lowering the passenger's seat in the front cockpit and fitting a sliding celluloid roof with side windows which can be opened or kept closed. It gives additional comfort to the passenger. The useful load carried on his seven weeks' tour was about 800 lbs., which included the weight of the pilot, passenger, fuel, a spare airscrew, spare magneto, five suit-cases and a boat-raft. Performance in take-off and climb were quite efficient with this load, and a ceiling of 8,500 ft. was touched during the flight.

No mechanical trouble was experienced beyond the necessity of changing a sparking plug and replacing a tail skid tube which required changing before the start from England.

The course taken was through Paris, Nice, Pisa, Naples, Catania, Tunis, Biskra, Algiers, Oran, Almeria, Seville, Madrid, Biarritz, and so back. On December 31, when the crossing from Oran, in North Africa, to Almeria, in Spain, was made in a cross wind of 50 m.p.h., the Spanish Navy lost one of its Dornier Wal flying-boats, which was flying in the opposite direction. The wreckage was washed ashore at Oran and no trace of the crew remained.

That sea stretch of 20 miles took the Westland monoplane 50 mins., and a landing had to be made through a duststorm in a cut maize field at Almeria.

Approximately 4,200 miles were flown during the tour in a flying time of 60 hrs. 50 mins. The longest non-stop stage flown was one of 350 miles in 3½ hrs., and during the last two days the monoplane was flying for 5 hrs. each day mostly in fog.

The cost of the tour, including the benefit of quite good hotels, was £3 10*s*. per day inclusive for the two tourists, which was, in part, due to an economical petrol and oil consumption. Ordinary car spirit was used and the consumption was 20 gallons for every 4¾ hrs. flying at a cruising speed of 80 to 85 m.p.h., while the amount of oil consumed for the whole flight was 32 litres.

A courteous reception was met everywhere, and the Spanish Army aerodrome at Seville was found to be one of the finest in Europe.

A golden eagle was sighted about twenty yards away when the monoplane was near Ouelma, in Algeria, at an altitude of 3,000 feet. Its opinion of the intruders was briefly expressed with one disdainful glance.

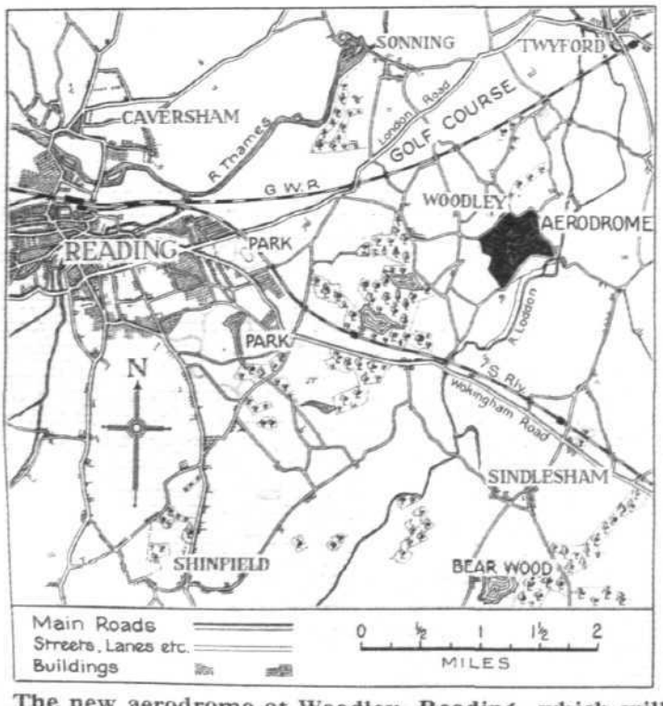
AERODROMES IN VIEW

Reading, Manchester, Liverpool and Retford, etc.

Reading is now in the first group of towns which is taking immediate action in the aerodrome question, although it owes its priority to private enterprise. Messrs. Phillips and Powis, of the Reading Motor Exchange, have acquired a site at Woodley, near Reading, which is said to be one of the best natural sites in the country.

It is about 130 acres in extent, roughly square in shape, and will afford a free run for take-off of over 700 yards in any direction. The soil is gravel, with a good level surface, and the drainage is excellent. Very little transformation is necessary. Hangars are in course of erection.

The approaches are reported on favourably, and the site is well marked from the air by railways and the River Loddon. Road approaches are also said to be good for the field is situated just 2½ miles east of Reading on the London and Wokingham roads, and there are main roads on three sides with two 'bus routes. The opening of the field is expected quite early in the season.



The new aerodrome at Woodley, Reading, which will shortly be opened by Messrs. Phillips and Powis, of the Reading Motor Exchange, with facilities for instructional flying and air-taxi work. In extent the field is 130 acres and affords a run of over 700 yards in any direction. It is a natural site and about 2½ miles east of Reading.

Wide flying facilities will be available. Instructors and aircraft will be in service at low rates of charge, and air taxi flights undertaken at all times to any aerodrome. New and second-hand aircraft will be sold. Visiting aircraft will meet with all necessary service, and there will be cars to convey people to and from the aerodrome.

Retford had an aerodrome during the war, located at Babworth, and although the hangars were eventually sold, some of the huts and foundations of other buildings remain. It is possible that a municipal aerodrome may arise in the district as the Mayor, although declaring himself no airman, has proposed that the Council should consider the matter seriously and give Sir Alan Cobham all the assistance required during his coming air visit to the town.

Liverpool has repeatedly been mentioned in connection with an aerodrome in the past, but progress seems to have been sluggish. It has a flying club, although that functions on the other side of the Mersey at Hooton Park aerodrome.

A deputation has now put forward the views of influential people in favour of an aerodrome on the Speke Hall estate, which was recently acquired by the Corporation. The deputation consisted of :—Mr. F. J. Marquis, chairman, Liverpool Organisation ; Councillors R. J. Hall and J. Graham Reece ; Mr. M. Anderson, manager, Liverpool Organisation ; Colonel A. Buckley, chairman, Liverpool Chamber of Commerce ; and Col. J. B. McKaig, Liverpool Aero Club.

Sir Max Spratt, Chairman of the Finance Committee, expressed the sympathy of the committee with the proposals and said that at Speke they had available land. Air Ministry officials had favoured the site. A question for the Corporation is to decide whether it should provide and manage the aerodrome itself or invite an outside organisation to submit a scheme.

Manchester Corporation Aviation Committee has now taken over the land at Chat Moss, and terms of compensation have been arranged with the farmers occupying it. The aerodrome will be ready about September, and meanwhile a temporary site on the Wythenshawe estate, which was acquired two years ago for building purposes, will probably be used, in which case an air taxi service will commence in April.

Middlesbrough Y.M.C.A. Junior Town Council considers that the town should have a municipal aerodrome in order to consolidate its position as the industrial centre of the Tees-side.

FLIGHT
THE AIRCRAFT ENGINEER & AIRSHIPS

LIGHT 'PLANE CLUBS

London Aeroplane Club, Stag Lane, Edgware. Sec., H. E. Perrin, 3, Clifford Street, London, W.1.
Bristol and Wessex Aeroplane Club, Filton, Gloucester. Secretary, Major G. S. Cooper, Filton Aerodrome, Patchway.
Cinque Ports Flying Club, Lympne, Hythe. Hon. Secretary, R. Dallas Brett, 114, High Street, Hythe, Kent.
Hampshire Aero Club, Hamble, Southampton. Secretary, H. J. Harrington, Hamble, Southampton.
Lancashire Aero Club, Woodford, Lancs. Secretary, Mr. Atherton, Avro Aerodrome, Woodford.
Liverpool and District Aero Club, Hooton, Cheshire. Hon. Secretary, Capt. Ellis, Hooton Aerodrome.
Midland Aero Club, Castle Bromwich, Birmingham. Secretary, Major Gilbert Dennison, 22, Villa Road, Handsworth, Birmingham.
Newcastle-on-Tyne Aero Club, Cramlington, Northumberland. Secretary, J. T. Dodds, Cramlington Aerodrome, Northumberland.
Norfolk and Norwich Aero Club, Mousehold, Norwich. Secretary, G. McEwen, The Aerodrome, Mousehold, Norwich.
Nottingham Aero Club, Hucknall, Nottingham. Hon. Secretary, Cecil R. Sands, A.C.A., Imperial Buildings, Victoria St., Nottingham.
The Scottish Flying Club, 101, St. Vincent Street, Glasgow. Secretary, George Baldwin, Moorpark Aerodrome, Renfrew.
Southern Aero Club, Shoreham, Sussex. Secretary, Miss N. B. Birkett, Shoreham Aerodrome, Sussex.
Suffolk Aeroplane Club, Ipswich. Secretary, Maj. P. L. Holmes, The Aerodrome, Hadleigh, Suffolk.
Yorkshire Aeroplane Club, Sherburn-in-Elmet, Yorks. Secretary, Lieut.-Col. Walker, The Aerodrome, Sherburn-in-Elmet.

LONDON AEROPLANE CLUB

REPORT for week ending February 24.—Pilot instructors: Captain V. H. Baker, M.C., A.F.C., Captain F. R. Matthews. Ground engineers: C. Humphreys and A. E. Mitchell. Aircraft: The following machines were in commission during the week: G-AABL; G-EBXS; G-EBZC; G-EBMP. Total flying time: 9 hrs. 15 mins. Dual instruction: 7 members received dual instruction during the week, the time being 7 hrs. Solo flying: 8 members flew solo during the week, the time being 2 hrs. 15 mins.

Except for very short intervals, fog prevented flying practically the whole of the week.

Mr. Scott-Taggart has now placed a definite order with the De Havilland Company for a "Gipsy" Moth fitted with slots which he is presenting to the club. This very generous presentation by Mr. Scott-Taggart is, of course, conditional on the club providing itself with a similar machine. Certain assistance has already been promised which has justified the club in placing an order with the De Havilland Company for this machine. It is hoped that these two machines will be handed over to the club in March.

Clubhouse Fund: The Committee desire to acknowledge with thanks the following further donations towards the Clubhouse Fund: P. W. Hoare, £1 1s., R. C. Presland, £1 1s., T. E. Rose Richards, £1 1s., A. F. Wallace, £1 1s., Lieut.-Col. H. H. Betts, £1.

The Air League Flying Scholarship: The Flying Scholarship of £50 presented to the London Aeroplane Club by the Air League of the British Empire has been awarded to Miss Audrey Kidston.

CINQUE PORTS FLYING CLUB

REPORT for week ending February 23.—Pilot instructor: Maj. H. G. Travers, D.S.C. Ground engineer: Mr. R. H. Wynne. Machines: de H. Moths RI and NN. Total flying time for week: 4 hrs. 35 mins. Dual instruction: Mr. Sargent, 45 mins. Soloist (under instruction): Mr. Sargent, 50 mins. "A" pilots: Mr. Douglas, 15 mins; Mr. Somerset, 1 hr. 30 mins. Tests, joyrides, etc.: 9; total, 1 hr. 15 mins.

The weather stopped flying on Sunday, Monday and Saturday of this week.

Easter Meeting: Entries have already been promised for the Manufacturers' Scratch Race from Messrs. de Havilland and Blackburn, while numerous private-owner entries have been received for the Cinque Ports Handicap Race, and both events promise to be successful. The support of foreign manufacturers and clubs will probably be obtained and entries from Holland are expected.

A Correction.—In the report of the Easter Meeting published last week it was stated, regarding the Manufacturers' Scratch Race, that this was open to any aeroplane fitted with an engine (or engines) not exceeding 5,000 c.c. This should read "5,500 c.c."

HAMPSHIRE AEROPLANE CLUB

REPORT for week ending February 23.—Pilot instructors: F./Lt. F. A. Swoffer, M.B.E., and Mr. W. H. Dudley. Ground engineers: Mr. E. Lenny and Mr. J. Elliott. Aircraft: D.H.60 Moth G-EBOH. Flying time for the week: 10 hrs. 20 mins. Pupils under instruction: (4), 3 hrs. 20 mins. Soloists: (2), 1 hr. 40 mins. "A" pilots: (4), 2 hrs. 45 mins. Instructors solo and tests: (5), 2 hrs. 35 mins.

On Sunday, Major Clarence Young flew from Hamble to Croydon in his Stearman biplane, which had been assembled in our hangar.

On Friday, Capt. Kirby flew to Shoreham in OH with Mr. Villiers as passenger. He was obliged to land on the return journey near Angmering owing to valve trouble. This, however, was soon put right and Capt. Kirby was able to return to Hamble without further adventure.

Another pilot member joined the club this week.

LANCASHIRE AERO CLUB

REPORT for week ending February 23.—Flying time, 17 hrs. Instruction (5), 2 hrs. 50 mins. Solo flights (15), 7 hrs. 20 mins. Passengers (9), 5 hrs. Tests (11), 1 hr. 50 mins.

Instruction (with Mr. Hall): Williamson, Tweedale, Sellers, Garner, Whitehouse. Machines on commission, XD, MQ, EC, QL.

Soloists (under instruction): Davies, R. G., Sellers, Whitehouse.

Pilots: Lacayo, Meads, Goodfellow, Tweedale, Harrison, Nelson, D., Mills, Weale, Gattrill, Twemlow, Cantrill, Hall, R. F.

Passengers (with Mr. Lacayo): Beenken, Hartley. (With Mr. Mills), Worthington. (With Mr. Hall, R.F.), Sellers, Davies, R. G., Williamson. (With Mr. Cantrill), Wilkinson, Cooper, Creach.

Damp misty weather set in with the thaw and flying conditions have been unpleasant. We sympathise with the London Club at Stag Lane. Even four machines in the air together on Sunday was quite sufficient to give most of us a chronic crick in the neck.

During the week Mr. Whitehouse completed all tests for his Royal Aero Club Certificate.

LIVERPOOL & DISTRICT AERO CLUB

REPORT for week ending February 23.—Machines in commission: Avro Avians XX and ZM. Instructors: Flight-Lieuts. J. B. Allen and F. A. Sullock (hon.). Ground engineer: Mr. Howard Pixton. Total flying for week: 13 hrs. 10 mins. Dual: (12), 8 hrs. 55 mins. Soloists: (2), 1 hr. 15 mins. "A" licence pilots (5): 1 hr. 30 mins. Passenger flights (3): 1 hr. Test flights (5): 30 mins.

Fog has seriously curtailed this week's flying, which for the exception of a really excellent show by Mr. I. Parker, in carrying out his flying tests for his "A" licence, has been rather an eventless week.

Curiosity has however, been aroused by the appearance of a new mechanic who has been seen putting in a lot of hard work on a certain Moth now hangared with us. Regaled in navvy's red and white choker, boiler suit, faultless fawn spats and highly lemon-coloured gloves he presents an imposing figure to all who have had the good fortune to have seen him. Rumours that the ground staff are hinting at the employment of blackleg labour are quite without foundation.

THE WINNIPEG FLYING CLUB: Miss Dorothy Bell entering the Club's D.H. "Moth," equipped with skis, to pass her tests at Stevenson Field, Winnipeg, on January 24, when the temperature was 15 degrees below zero. In the group are (left to right) Flt. Lt. L. R. Charron (examiner), Miss D. Bell, Flt.-Lt. A. Carter (examiner), Mr. Allan Keith, Michael de Blicquy (pilot instructor), and Messrs. W. Ross and P. McBean. (Note the skis on the machine.)

MIDLAND AERO CLUB

REPORT for week ending February 23.—The total flying time was 31 hrs. 30 mins. Dual: 14 hrs. 20 mins. Solo: 13 hrs. 10 mins. Passenger: 3 hrs. 30 mins. Test: 30 mins.

The following members were given dual instruction by Flt./Lt. T. Rose, D.F.C., and W. H. Sutcliffe: J. B. Briggs, L. V. Menn, J. H. Stevens, Mrs Leigh Fermor, J. N. Fisher, H. C. W. Shaw, C. T. Davies, G. P. Haylock.

Advanced Dual: H. J. Willis, W. L. Handley, R. C. Baxter, R. L. Jackson.

"A" Pilots: R. C. Baxter, H. J. Willis, J. Rowley, S. H. Smith, M. A. Murtagh, E. P. Lane, R. L. Jackson, E. D. Wynn, F. J. Steward, C. W. R. Gleeson.

Soloists: J. B. Briggs, W. L. Handley, L. V. Mann, Mr. Blakeway, J. K. Morton, A. E. Coltman.

Passengers: S. James, A. Methley, G. C. Jones, E. Hauson, L. V. Mann, R. L. Jackson, J. N. Fisher, R. C. Baxter, A. Corlyn-Hale.

Mr. J. B. Briggs passed the flying tests for his "A" licence.

Mr. C. W. R. Gleeson has joined the ranks of private owners. He has bought the Moth EBLV, formerly the property of Mr. Kenneth Twemlow. Eight machines are now housed in the club hangar.

Mr. Lacayo, of the Lancashire Club, landed here on Wednesday in an Avian.

NORFOLK & NORWICH AERO CLUB

REPORT for week ending February 24.—Pilot instructor: J. C. Houston, M.C. Ground engineer: A. Kirkby. Machines: (3), ZW, QX, XE. Total flying time: 17 hrs. Hours flown, dual: 3 hrs. 55 mins. Solo training: 1 hr. 55 mins. Solo "A" licence: 10 hrs. 55 mins. Tests: 15 mins.

We have to congratulate Mr. Rope on successfully completing his tests for "A" licence this week, and also our G.E., Mr. Kirkby, who has been taking instruction for some time and last week completed all tests. We have had some better weather this week, although some fog has been prevalent. On Friday the annual dinner was held at the Maid's Head Hotel, and we were very pleased to have Sir Sefton Brancker and Sqdn.-Ldr. Bert Hinkler with us. It was unfortunate that Lady Bailey was unable to come owing to a death in the family. The room was full, as the 106 tickets available had all been sold nearly two weeks before, and although some were returned through illness they were quickly re-allotted. We were also glad to have with us Dr. Sleigh, Chairman of the Suffolk Club, who responded to the toast "Kindred Clubs."

(A full report of the Dinner appears on page 163.)

SOUTHERN AERO CLUB

REPORT for week ending February 24.—There has been a fair amount of flying activity during the week. In this respect we are lucky, for we are seldom held up by fog when it is prevalent further inland.

In addition to a good deal of instruction work on Avro G-EBYB, Mr. Miles and Mr. Pashley took the opportunity of flying an S.E. 5A on Sunday. Mr. Miles flew to Croydon on Wednesday and Hamble on Thursday.

On Friday, Capt. Kirby and Mr. Villers visited us on a "Moth" from the Hampshire Club.

SUFFOLK & EASTERN COUNTIES AEROPLANE CLUB

REPORT for week ending February 23.—Instructor: G. E. Lowdell, A.F.M. Ground engineer: E. Mayhew. Aircraft: Three Blackburn "Bluebirds," RE, SZ, and UH. Aerodromes: Hadleigh, Suffolk, and Conington, Cambs. Seaplane Base: Brightlingsea, Essex. Flying time for week: 14 hrs. 35 mins. by Suffolk and Cambridge Clubs, as follows:—

Suffolk Aero Club.—Flying time: 10 hrs. 5 mins. Seven members were given dual (2 hrs. 50 mins.). Two members flew solo under instruction (1 hr. 45 mins.). Flights were made by five "A" licence members (4 hrs. 35 mins.). Six passengers were carried (30 mins.). Five tests were made (25 mins.).

Mr. Garner successfully accomplished his figure of eights, but mist and low clouds prevented him from trying for his height test.

Mr. Collingwood made a cross-country trip to Norwich. There has been little of moment to record during the week, except a slight improvement in the weather which is reflected in the flying time.

Cambridge Aero Club.—Flying time: 4 hrs. 30 mins. Four members had dual (2 hrs. 45 mins.). Flights were made by one "A" licence member (15 mins.). One passenger was carried (1 hr. 30 mins.).

Another new member started dual during the week. There are now quite a number of new members under instruction at Conington.

It has been decided to hold an Air Display at the Cambridge Aero Club, since this is now a very live and going concern, on Easter Monday, April 1. It is hoped that all who possibly can will support this initial venture of a new club. There will be an On to Cambridge Rally, and other events such as bomb dropping. Those interested should write to the Secretary, Suffolk & Eastern Counties Aeroplane Club, Ltd., The Aerodrome, Hadleigh, Suffolk. Further particulars will be published shortly.

"FLIGHT" *Photograph*

GIPSY-MOTHS FOR CHILI: Capt. Montecino, a Chilian pilot, who has been testing sixty-four Gipsy-Moths at Stag Lane Aerodrome, Edgware, which were ordered from the De Havilland Aircraft Co. by the Chilian Government.

YORKSHIRE AEROPLANE CLUB

REPORT for week ending February 23.—Pilot Instructor: H. V. Worrall. Ground engineer: R. Morris. Machines in commission: (3), TB, SV and RF. Flying time: 9 hrs. 45 mins. Instruction: (7), 4 hrs. 35 mins. Soloists: (2), 1 hr. 20 mins. "A" Pilots: (4), 3 hrs. 20 mins. "B" Pilots: (1), 10 mins. Passengers: (1), 10 mins. Test Flights: (2), 10 mins.

Fog and mist have made flying practically impossible except for very short spells during the week.

Visiting Aircraft.—Mr. D. Fairweather, of the Scottish Club, and Mr. J. D. Irving, of the Newcastle Club.

FROM THE FLYING SCHOOLS

Brooklands School of Flying, Brooklands Aerodrome

REPORT for week ending February 24.—Managing Director: H. D. Davis. Instructors: Capt. H. D. Davis, Capt. E. E. Jones, and Maj. C. M. Pickthorn. Flying time: 10 hrs.

Once more we must complain of the ficklesness of our weather. Our week started in grand style and the machines were kept busy by our resident pupils, who are already showing great promise. After this hopeful start we were suddenly faced with fog, fog—nothing but fog, and even then our pupils would still be in the air, if they had their way!

Henderson Flying School, Croydon Aerodrome

REPORT for week ending February 24.—A miserable week, marked, however, by two first solos, both successful. By the way, as an encouragement to "B" licence pupils, Mr. Allen, a recent pupil of the Henderson Flying School, *ab initio* to the finishing stage, has been appointed as week-end instructor to a neighbouring firm after only 35 hrs. solo—the official minimum. He has, moreover, been accepted by the insurance people—who seem to know a thing or two about standards of teaching.

It is, however, still free for people to decide whether to be taught by Col. Henderson, or one of his many pupils.

Next month will see at least six "B" licence "hustle" finishes on the school machines.

North Sea Aerial and General Transport, Ltd., Brough Flying School

REPORT for week ending February 23.—Last week gave us relief from snowstorms, and a spell of warmer weather has removed the snow from the aerodrome. Visibility has been consistently poor throughout the week, however, and has interfered with flying to some extent.

Flying Officers Lumsden, Lane and Atkinson received 10 mins. dual instruction on "Kangaroos" and carried out 14 hrs. 15 mins. solo, while test flights by Messrs. A. G. Loton and J. B. Stockbridge occupied a further 25 mins.

Flying Officer Lane completed two quarters training on Wednesday, and Flying Officer Atkinson left on Friday, having carried out his flying for fou-quarters.

Messrs. H. W. Hall and J. Riddell received 1 hr. 20 mins. dual on "Bluebirds" during the week, and a test flight by Capt. Blackburn accounted for a further 40 mins., making the total for the week 16 hrs. 50 mins.

Surrey Flying Services School of Flying, Croydon Aerodrome

REPORT for week ending February 23.—Instructor: J. J. Flynn. Ground engineers: R. Fox and F. La Croix (Croydon Aerodrome). Aircraft: 1G-EBIV. Flying time, 7 hrs.; soloists, 1 hr. 45 mins.

Although we had only two reasonably good flying days during the week, we managed to send off two more soloists, Mr. Fox on Thursday and Mr. Rogers on Friday, who put up a very good show with only 6 hrs. dual.

Mr. Brunning also did a further 45 mins. solo, and now awaits decent weather to complete his tests for his "A" licence.

Mr. Fleetwood has his hands full in the workshop, where he is, together with his assistants, busy getting ready two Avros for customers, in addition to the work on aircraft for ourselves.

OVERSEAS CLUBS

VICTORIA AERO CLUB, B.C.

REPORT for month ending January 31.—This club has been out of operation for practically two months owing to a piston breaking in the motor and subsequent delay in obtaining the replacement parts found necessary whilst overhauling the motor. We are now glad to be able to report that our Moth is again in flying condition.

On the 23rd inst., test flights were made by Mr. Sydney Pickles, who is acting as hon. air engineer to the club, who found everything in order and certified the machine as airworthy and ready for the resumption of instruction.

On the 25th inst., Mr. A. H. Wilson, who is acting as temporary instructor to this club, had the machine out for further flights, but no instruction was possible owing to the weather.

The first snowfall in Victoria this winter prevented further flying till the 29th inst., when Mr. A. H. Wilson was out again giving instruction to Mr. G. S. Burns.

Owing to complaints regarding the noise of the club Moth, we have drilled 62 ¼-in. holes along the exhaust pipe and flattened the end to form a fish tail. The result is a considerable decrease in the exhaust noise without any falling off in the power of the motor, the R.P.M. being maintained as before. This may be of interest to others who are in a similar position to this club, of operating in close proximity to a hospital.

Further, to facilitate the draining of the oil from the motor, in order to pre-heat same before starting up in cold weather, we have fitted a ¼-in. screw down gate valve to the drain plug. This valve eliminates wear and tear on the drain plug from the frequent unscrewing of same. We feel that the interchange of operating hints, published in the club news would be of all round assistance.

FLIGHT

PETROL FROM COAL

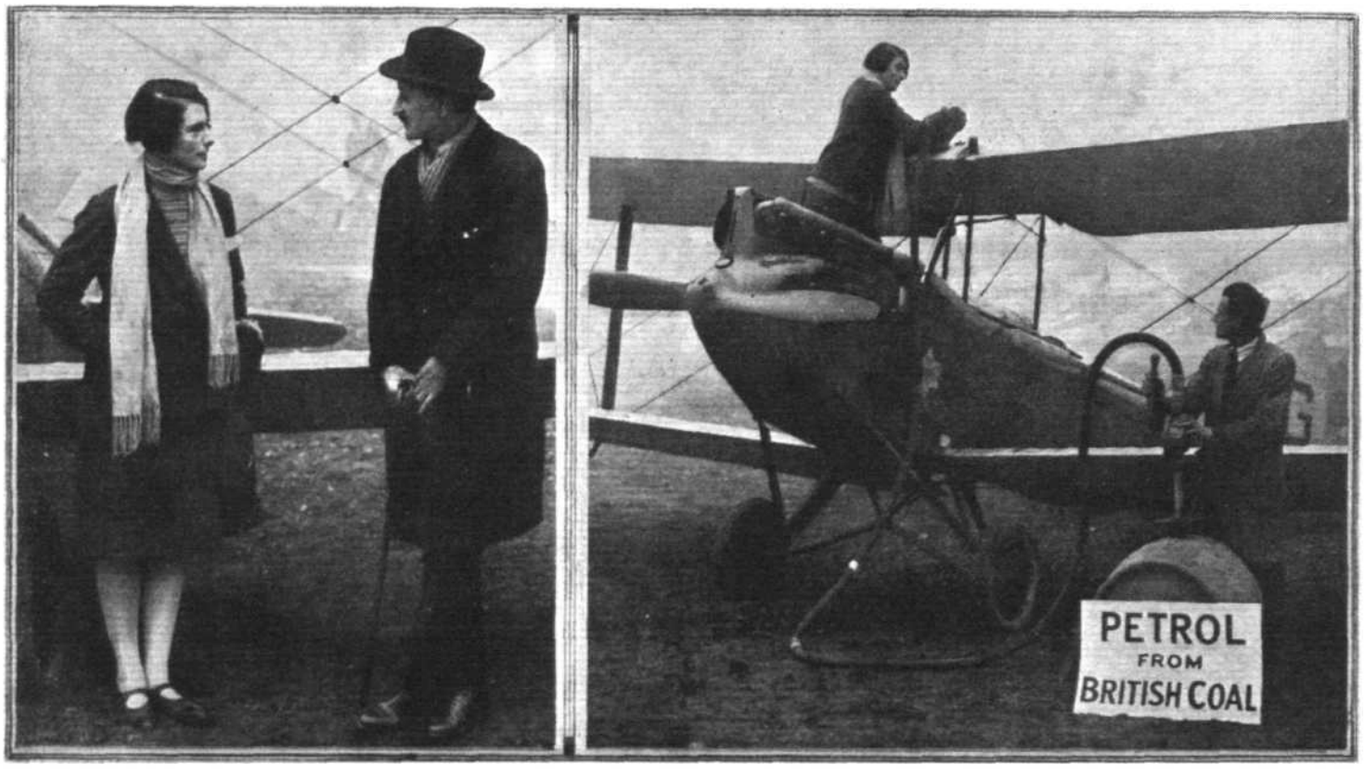
THE mere starting up of an Armstrong-Siddeley "Jaguar" engine and a De Havilland "Gipsy" engine at Stag Lane Aerodrome, Edgware, on February 22, indicated significant development in the world of fuels. These two engines were run up quite normally on petrol, which had been obtained from British coal by a process of low-temperature carbonisation, which is to be commercialised in this country.

Had not a thick foggy atmosphere screened the aerodrome, which is now rapidly becoming surrounded by De Havilland works, there would have been flying tests by Miss Winifred Spooner, the private-owner, on her Gipsy-Moth, Captain H. S. Broad, also on a Gipsy-Moth, and Captain R. W. Reeve on a D.H.9.J. with the Armstrong-Siddeley "Jaguar."

clear to economists but a riddle to politicians, will be relieved when the new industry makes its demands upon our mines. Then some independence of foreign supplies will accrue, although a considerable time must necessarily elapse before we can even partly satisfy our enormous market.

At the present time no British coal-petrol is being sold to the public as a proprietary article, but it is significant that since July, 1927, one British low-temperature carbonisation plant alone has produced 1,850,000 gallons of crude oil and 160,000 gallons of motor spirit.

Another significant factor is, that after the coal has been subjected to low-temperature carbonisation, and the petrol obtained from cracking the oil given off, the residual smoke-



["FLIGHT" *Photographs*

PETROL FROM COAL: Our illustrations mark the occasion at Stag Lane Aerodrome, Edgware, on February 22, of the first official demonstration of running aero-engines on petrol obtained from coal. Miss Winifred Spooner, the private-owner, is seen discussing the fuel tests she made with her Gipsy-Moth (on the right) with Lord Thomson, who was Air Minister in the Labour Government. An Armstrong-Siddeley "Jaguar," in a D.H.9.J. training machine, was also run up successfully with "coaline," as the new fuel is called.

Captain Broad proposed to stunt: to show, for instance, how the engine picked up on the new fuel after upside-down flying. But flights have taken place at Stag Lane Aerodrome, and they have shown that the fuel can be used successfully on internal-combustion engines.

No difference in performance was noticed, and no alterations for carburation were necessary. There is one superficial defect at the moment, and that is, the unsavoury odour of the coal-petrol, but that, one was assured, can easily be cured.

Lieut.-Col. W. A. Bristow, Managing Director of Low Temperature Carbonisation, Ltd., Coalite House, 28, Grosvenor Place, S.W.1, who arranged the demonstration, gave an explanatory statement on the process.

From this we gather that there seems to be big potentialities associated with this experiment with coal fuel. For one thing, the mining situation in this country, which is less carbon is of high radiant efficiency, and capable of use for our domestic purposes.

Our present annual domestic consumption of coal is something over 40,000,000 tons. This total would yield about 800,000,000 gallons of oil, which would give about 350,000,000 gallons of petrol after cracking, to which could be added about another 100,000,000 gallons recovered from the gas, making a total of 450,000,000 gallons. That figure represents more than half our present motor spirit requirements.

The exemption of British-made petrol from a duty of fourpence per gallon also gives a new orientation to the commercial and technical aspects of the process for obtaining British fuel.

Shortly a plant will be laid down in Yorkshire to carry out this process, the rights of which have been acquired by Petroleum Refineries, Ltd.

◈ ◈

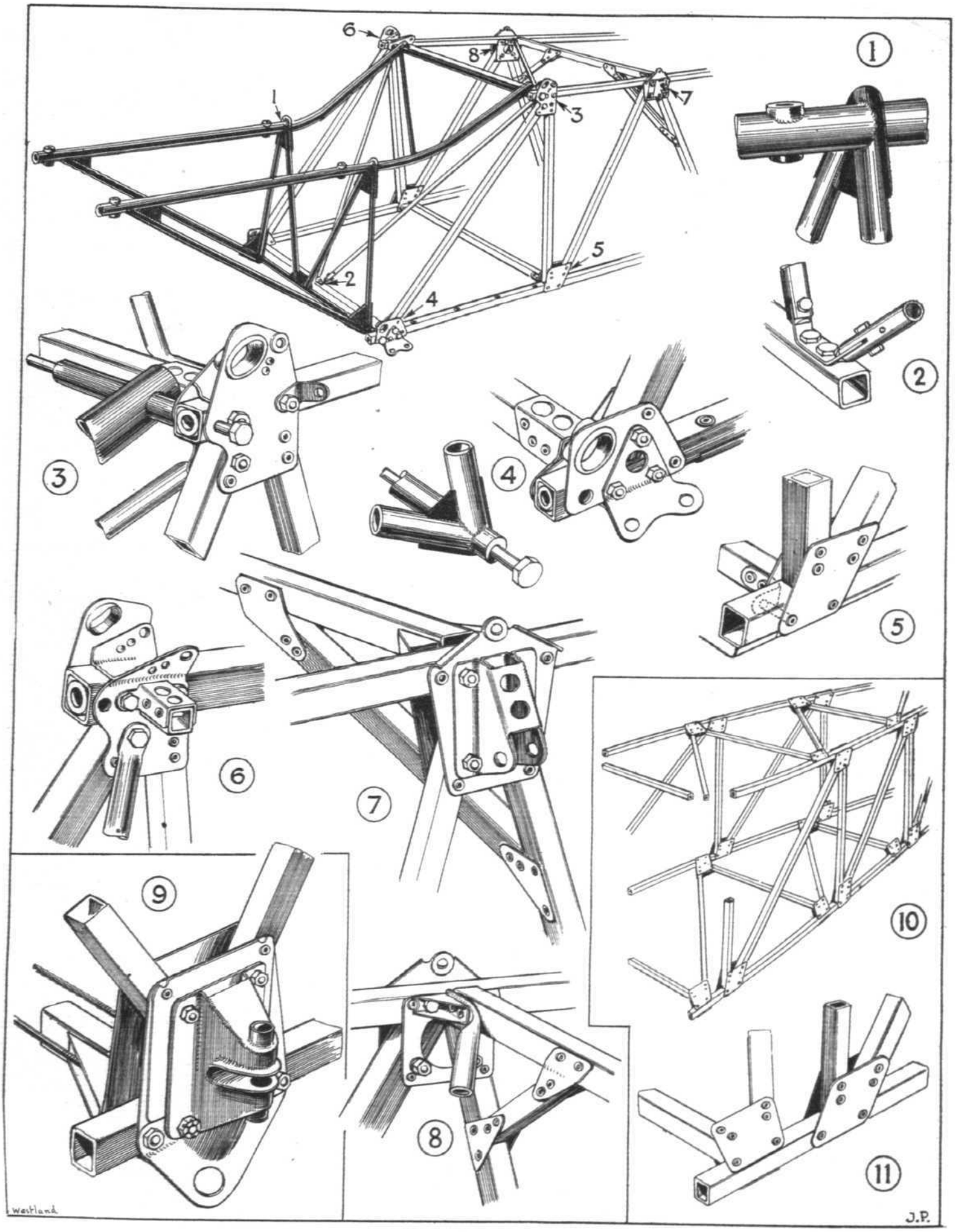
Airscrew Body Interference

WE would remind our readers that a lecture on this important subject—Airscrew Body Interference—will be given by Mr. C. N. H. Lock, before the R.Ae.S. & Inst. Ae.E., on March 7 next. Mr. Lock has been concerned with this research for some time, and has carried out some very important investigations, developing a theory of interaction which has been found to account for many of the observed facts. His work undoubtedly will go far to clear up a subject that has presented many difficulties in the past. The time of the lecture is 6.30, as usual, and the place, the Royal Society of Arts. It will be illustrated.

◈ ◈

Airman Washed Up

THE *Times* Paris correspondent says that the body of M. Lécrivain, the pilot of the France-South America air mail, who, with his wireless operator, was lost on January 31 off the African coast, has been found on the shore between Agadir and Mazafan.



["FLIGHT" *Sketches*

THE METAL VERSION OF THE WESTLAND "WIDGEON" LIGHT 'PLANE: This machine is now coming through the works at Yeovil, and the above sketches show some of the constructional features of the fuselage. The engine mounting (for an "in-line" engine) is a separate unit, and is of welded steel tube. The main fuselage is of square-section Duralumin tube. The lug at 4 is the attachment of the front struts of the float undercarriage. A new type of "split" land undercarriage is now fitted, and the telescopic leg is attached at 7. 9 is the wing-strut attachment, and the tension across bottom of fuselage is taken by tie rods. The general scheme of the rear portion of the fuselage is as shown in 10, and the method of attaching struts to longerons is as shown in 11.

FLIGHT

AIR-COOLED ENGINES IN SERVICE*

(*Concluded from p.* 144.)

Air-Cooled Engine Installation

THE question of air-cooled engine installation is a subject covering a wide field which I cannot attempt to deal with in this paper, but there are certain broad principles affecting air-cooled engines in service to which I wish to refer, which are as follows :—

(*a*) *Cooling Capacity.*—In Mr. Penn's paper, entitled "Aeroplane Engines in Flight," which he read before the Royal Aeronautical Society last November, he gave us some interesting data in respect of the experimental work carried out at the R.A.E. to determine the cooling capacity and radiator efficiency on water-cooled engine installations. Up to the present time no such basis has been laid down for air-cooled engines.

From a theoretical point of view, each air-cooled engine should have a different fin capacity according to the aircraft into which it is installed ; this, of course, is impractical, but it is submitted that some definite schedule should be laid down for measuring cylinder and crankcase temperatures in a new installation.

The same air-cooled engine is often installed in many different aircraft ; in one instance the cylinders are exposed to the slip stream and there is a free get-away for the cooling air, and in the next machine the same engine may be installed eccentrically, or where there are projections behind certain cylinders, and the air speed over the cylinders is as much as 30 per cent. less than in the first instance.

I believe this problem has been masked on air-cooled engines because on the water-cooled engine, if the cooling capacity is insufficient, trouble is experienced at once. In the case of the air-cooled installation, the engine is more patient and does not so quickly and so violently object to the way it has been installed, and it is quite possible for the engine to run for a considerable period before trouble is experienced. The Bristol Company are endeavouring to remedy this defect by supplying to their customers a simple equipment which will quickly determine whether the engine has been properly installed or not.

(*b*) *Crankcase Cooling and Lubrication.*—It is quite common for the crankcase temperature on an air-cooled engine to vary as much as 50 per cent. with the same type of engine in different installations, and the effect of such a difference in temperature is obvious on the actual working clearances and the temperature of the lubricating oil. Generally speaking, the slower the machine, the greater the need for adequate crankcase ventilation. Crankcase temperatures materially affect the distribution and general running of the engine. Here again, it is considered that the engine constructor should provide a more definite schedule as to the temperatures permissible. This matter should be closely investigated on each new type of machine.

Fairly recently there has come to my notice a case where four identical air-cooled engines were in competition in different aircraft. All four machines had, to the eye, a very similar type of cowling ; three required oil coolers, and the fourth functioned absolutely satisfactorily without any oil cooler at all.

As the machines were built for the same competition, the difference in speed range was not sufficiently great to account for this discrepancy, and the machine in question had undoubtedly some cooling characteristics very different to the others.

These remarks apply to the radial type of engine, with which I am familiar, but I am quite convinced that similar remarks apply to the in-line air-cooled engine, and that if in the future we are going to see large air-cooled in-line engines functioning satisfactorily, reasonable care and intelligence will have to be used to develop a scheme by means of which the necessary velocity of air is passed through the fin cells of each individual cylinder with minimum disturbance and interference.

(*c*) *Air Intake and Exhaust Outlet Systems.*—All petrol engine carburettors require some form of heating. The air-cooled engine employs either hot oil, warm air from the cylinders, or hot spot from the exhaust gases. Oil, owing to its low specific heat, is a poor medium for this purpose, and sometimes recourse has to be made to one of the other two methods.

The problem is not so easy as it looks, because of the many different installations and the divided responsibility of the aircraft and engine builder, but I have proved that the service obtained from an engine has been seriously upset owing to the incorrect fitting of air intakes.

What is wanted is some system which does not require individual attention on each installation, and eliminates the rather haphazard "cut and try" method which is so often in operation, and I suggest that the solution of the matter is some definite flame damping device in the induction system, which will enable the air intake to be placed with safety inside the cowling ; that this air intake should be provided with some simple form of air cleaner, and that the induction system should be provided with exhaust heating, which can be definitely controlled from the pilot's cockpit.

Exhaust heating in my opinion is absolutely necessary for reliable running and good distribution in cold climates.

If the engine maker will face up to some such system as outlined above, this could be made universal for all types of aircraft, and would, I am quite sure, prolong the service obtained from air-cooled engines.

For comfort and night flying the exhaust gases on an air-cooled engine require dealing with adequately, and I believe that an air-cooled engine, with a properly designed collector system, gives better service than without, but if the system is of insufficient area the cylinder temperatures of the engine are naturally increased, with serious results to the engine generally, and indifferent service is certain to ensue.

The question of fire prevention also comes into this matter, and it is most important that the collector should be so arranged that it is not shielded from the slip stream on any surface and so has hot spots which would cause dangerous temperatures.

(*d*) *Fuel and Oil.*—The service rendered by air-cooled engines is affected by the use of suitable fuel and oil, and it is not so very long ago that the makers of British air-cooled aero engines were criticised in respect of the grades of fuel and oil they demanded, and it was stated that the American air-cooled engines would run on any ordinary grade of fuel and oil. It is significant to note that at the Aeronautical Conference at Chicago in December last these views were modified, and that as a result of considerable experience gained from operating air-cooled engines in America it was brought out that it paid to use good fuel, and definite standards are about to be drawn up for fuels for air transport in America. Fortunately in England we are provided with excellent fuels, but in some foreign countries air-cooled engines are expected to run on low grade fuels for which they have not been designed. If the carburettor heating is on the lean side the effect on the engine with this low grade fuel is far more serious, and I believe this is a further claim for variable heating control.

I think, probably, the most simple solution is the use of dope, and it behoves the engine builder to see that his valves, valve seats, valve guides, etc., are capable of coping with reasonable quantities of such dope as ethyl fluid.

As a result of some considerable experimental work on air-cooled engines, I have definitely proved that reasonable quantities of dope can be used without affecting the service of the engine.

On the question of lubrication oils, I think there is a good deal more to be said for the American view. The best oil is the cheapest in the long run from a service point of view, but owing to storage and climatic conditions, it is impossible, in certain countries, to use compounded oil, and we must get down to pure mineral oil for air-cooled engines.

Some considerable amount of experimental work has been carried out lately by the Armstrong-Siddeley and Bristol Companies, and long tests on pure mineral oil have been made with complete success, and I think within a short time we shall see air-cooled radial engines in this country operating regularly on pure mineral oil. The use of pure mineral oil will certainly help the dope question.

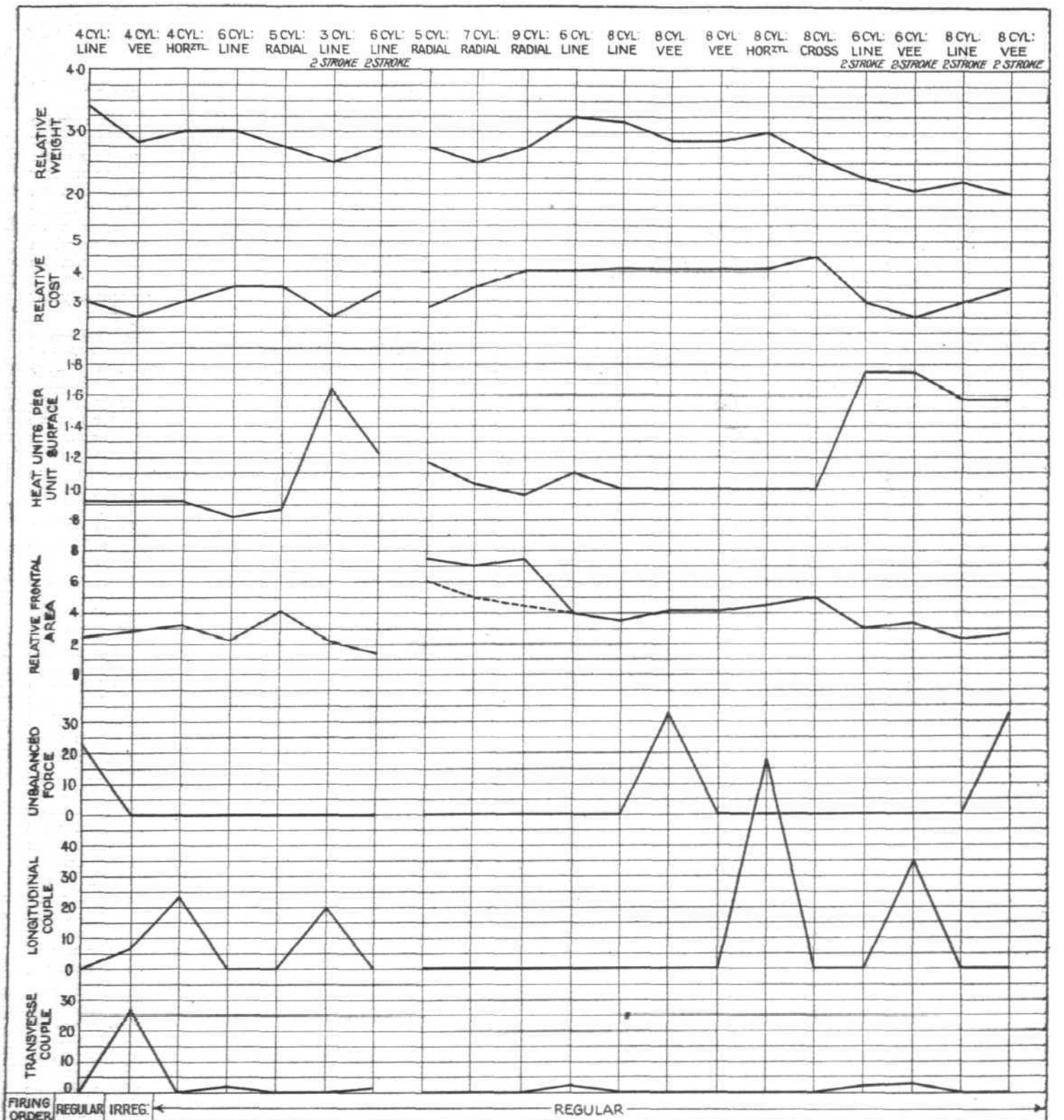
I think we are in a position to ask aircraft constructors, as an inducement to use mineral oil, to instal, at any rate on all commercial aircraft, a proper oil cleaner. Such a cleaner will, I am convinced, considerably extend the service rendered by air-cooled engines.

The Possible Lay-out of Air-cooled Engines

Most of the foregoing remarks in this paper apply directly to the air-cooled radial engine, because this is the type of engine with which I have been most closely associated.

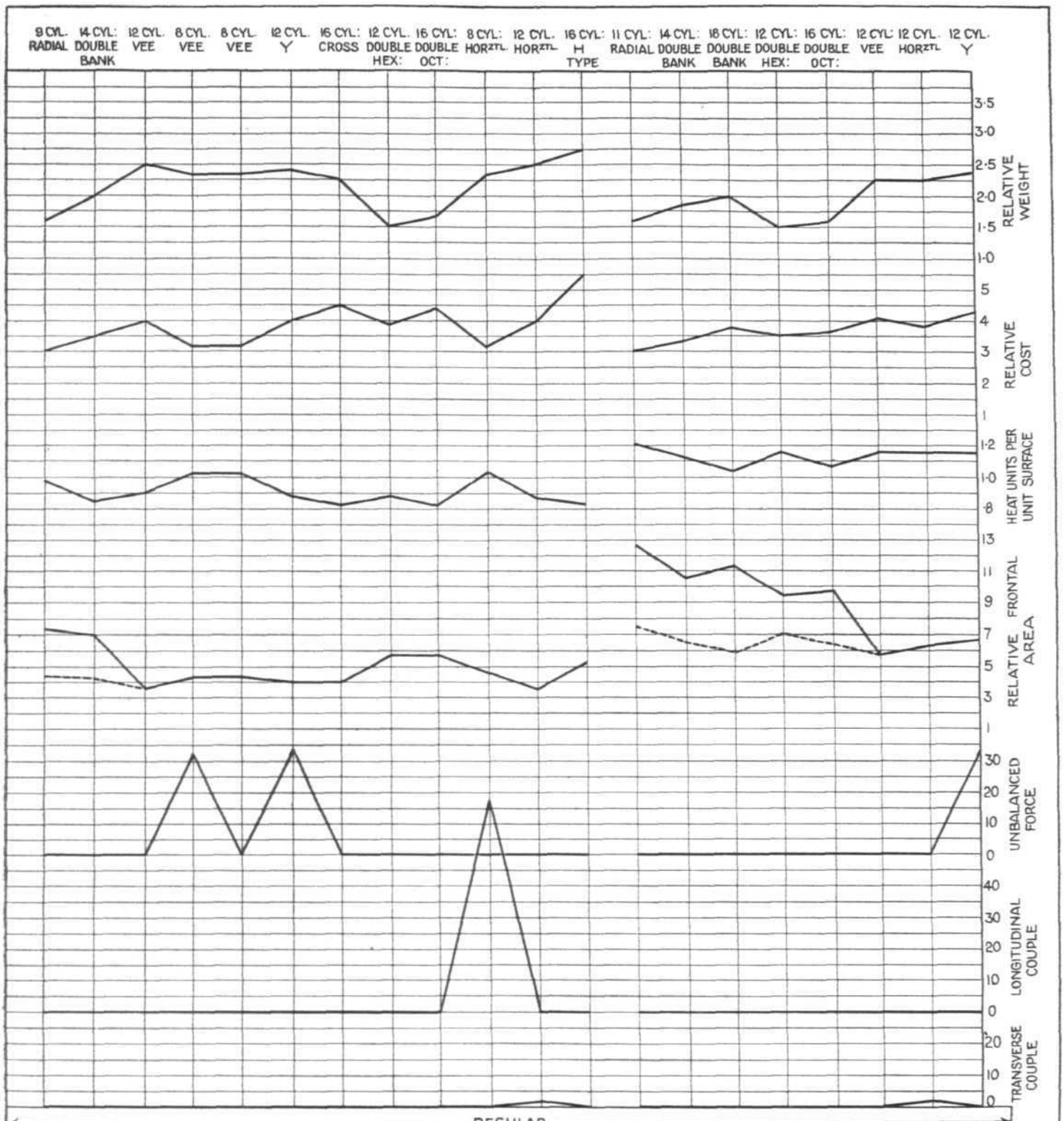
During the last few months, however, a great deal of

* Summary of Paper read before R.Ae.S. on Feb. 14, 1929.



TYPE	4 CYL: LINE	4 CYL: VEE	4 CYL: HORZTL	6 CYL: LINE	5 CYL: RADIAL	3 CYL: LINE 2 STROKE	6 CYL: LINE 2 STROKE	5 CYL: RADIAL	7 CYL: RADIAL	9 CYL: RADIAL	6 CYL: LINE	8 CYL: LINE	8 CYL: VEE	8 CYL: VEE	8 CYL: HORZTL	8 CYL: CROSS	6 CYL: LINE 2 STROKE	6 CYL: VEE 2 STROKE	8 CYL: LINE 2 STROKE	8 CYL: VEE 2 STROKE
BORE × STROKE	4·5 × 5	4·5 × 5	4·5 × 5	4 × 4·5	4·2 × 4·75	4 × 4·5	3·125 × 3·5	5·7 × 6·4	5·1 × 5·75	4·7 × 5·25	5·375 × 6	4·875 × 5·5	4·875 × 5·5	4·875 × 5·5	4·875 × 5·5	4·875 × 5·5	4·25 × 4·75	4·25 × 4·75	3·875 × 4·375	3·875 × 4·375
STROKE/BORE RATIO	1·125 : 1							1·125 : 1												
B.M.E.P.	110 LBS/SQ. IN.							120 LBS/SQ. IN.												
B.H.P.	80-100 B.H.P.							200-250 B.H.P.												

Comparative **characteristics of various air-cooled engine arrangements.**



9 CYL. RADIAL	14 CYL. DOUBLE BANK	12 CYL. VEE	8 CYL. VEE	8 CYL. VEE	12 CYL. Y	16 CYL. CROSS	12 CYL. DOUBLE HEX.	16 CYL. DOUBLE OCT.	8 CYL. HORZTL.	12 CYL. HORZTL.	16 CYL. H TYPE	11 CYL. RADIAL	14 CYL. DOUBLE BANK	18 CYL. DOUBLE BANK	12 CYL. DOUBLE HEX.	16 CYL. DOUBLE OCT.	12 CYL. VEE	12 CYL. HORZTL.	12 CYL. Y	TYPE
4·75 × 5·375	4·1 × 4·625	4·3 × 4·85	4·95 × 5·57	4·95 × 5·57	4·3 × 4·85	3·92 × 4·4	4·3 × 4·85	3·92 × 4·4	4·95 × 5·57	4·3 × 4·85	3·92 × 4·4	5·8 × 6·5	5·375 × 6	4·93 × 5·55	5·625 × 6·375	5·125 × 5·75	5·625 × 6·375	5·625 × 6·375	5·625 × 6·375	BORE × STROKE
1·125 : 1												1·125 : 1								STROKE/BORE RATIO
130 LBS/SQ. IN.												125 LBS/SQ. IN.								B.M.E.P.
350-450 B.H.P.												500-600 B.H.P.								B.H.P.

Comparative characteristics of various air-cooled engine arrangements.

attention has been given generally, and in the Press, to the in-line air-cooled engine, and prophesies have been made that this type of engine is going to entirely displace the air-cooled radial. So much so is this the case that only a few months ago, in this very room, I was asked by an authority on aviation why it was that the Bristol Company were falling so far behind in the air-cooled engine world, in so much that they were not producing an in-line air-cooled engine.

Now, I do not believe that the air-cooled radial engine is on the wane. It is impossible and undesirable for me to go at length into the reasons why I think this is so.

I have already endeavoured to outline, in a previous paper, my views as to the advantages of the air-cooled radial engine as regards light weight, production and repair facilities, use of symmetrical components, and comparatively easily-obtained raw material, etc.

These very real and practical advantages have been proved on many different types of aircraft in all countries during the last few years, and are the main reasons why aerial transport companies are, almost without exception, demanding air-cooled radial engines on nearly all their new and projected types of commercial aircraft throughout the world.

In championing the air-cooled in-line engine, a meritorious effort is being made to reduce the drag of the air-cooled radial, and I hope that there will be several definite fields for the air-cooled in-line engine, apart from the smaller sizes already employed on light aircraft.

The 4-cylinder in-line "Cirrus" and "Gypsy" have already proved what can be done in this direction.

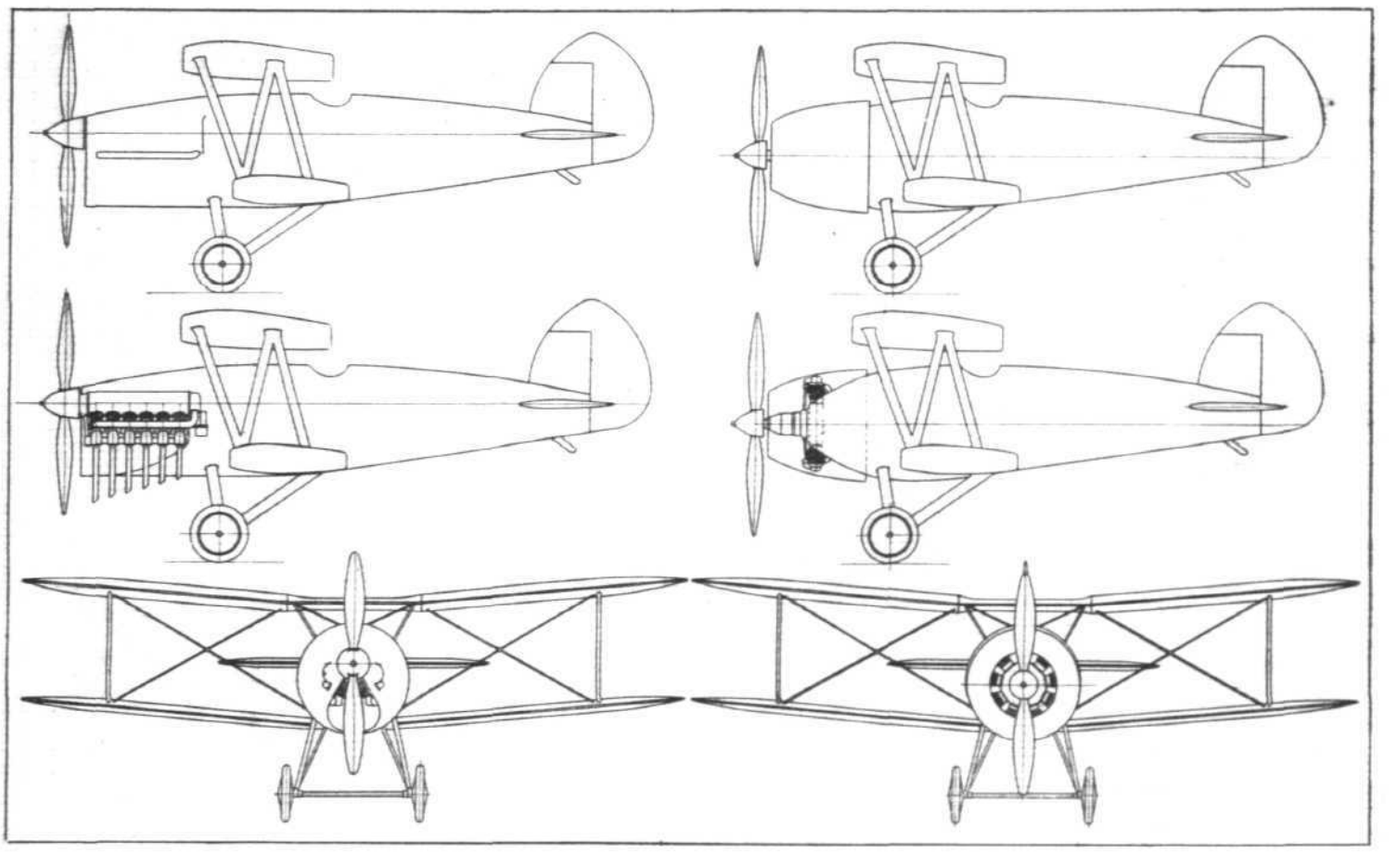
I am of the opinion, however, that with larger types of in-line air-cooled engines, which entail cylinder bores of 5 in. and upwards, the cooling problems will require considerable attention, and it will be very interesting to ascertain how much difference there will be between the large air-cooled radial and corresponding in-line engine, provided they are both given the same chance as regards cowling, and the lead-in of the cooling air to their respective fin cells with the minimum drag and interference.

I feel that there is somewhat undue optimism in regard to the performance to be obtained from the large air-cooled in-line engine in this respect, and I am also convinced that there is much to be done by improving the lay-out and consequent drag of the air-cooled radial engine by suitable cowling.

There is a considerable amount of experimental work proceeding at the present time along the line of reducing the drag of the air-cooled radial, which it would be premature to discuss in this paper, but if the aeroplane designer will give the radial engine maker as much consideration in cowling as the in-line engine maker will undoubtedly require, I think we shall see very interesting results.

As there has been so much talk of late as regards the most suitable types of air-cooled aero engines, I propose to conclude this paper by being sufficiently rash to consider some alternative lay-outs for various sizes of air-cooled engines most urgently needed for present requirements. The types of engines I have dealt with are as follows, viz. :—

1. The 80 to 100 h.p. engine.
2. The 200 to 250 h.p. engine.
3. The 350 to 450 h.p. engine.
4. The 500 to 600 h.p. engine.



COMPARATIVE SINGLE-SEATER INSTALLATIONS: On the left a 12-cyl. Vee air-cooled, and on the right a 9-cyl. totally enclosed radial air-cooled. Both of 400 h.p.

In forming conclusions the following qualities have been considered :—

1. Regular firing order.
2. Transverse couples.
3. Longitudinal couples.
4. Largest unbalanced force.
5. Frontal area—actual and equivalent.
6. Heat units dissipated per unit surface.
7. Simplicity and manufacturing characteristics, which mean prime cost and maintenance.
8. Weight.

The above characteristics are plotted in the form of graphs. I realise that such a graph is very ambitious and open to any amount of dissection and criticism, but I hope it may be possible to draw some constructive conclusions from it. Starting at the bottom, the first division shows the four different classes of engine. The next heading shows the M.E.P. that I have chosen for each class of engine. In each case I have taken a stroke/bore ratio of 1·125 to 1.

Following up the column you will then note the bore and stroke of each engine, and the type of engine and number of cylinders. In each category I have endeavoured to keep down the number of cylinders to the minimum, commensurate

with a reasonable torque curve. I have selected what I believe to be ideal bore and stroke conditions, and the figures do not necessarily refer to any particular type of engine. In practice most engines have to cover a wide range and there is some reason why the most ideal dimensions have not been chosen.

Following up the chart you will note in diagram form the crank lay-out of each type of engine and that the firing order is regular in every case, except the one example of the 4-cylinder 90° twin in the lowest horse-power category.

Passing to the first four main sections of the graph, these have been plotted as the result of an investigation of the balance and firing order of the different types under review. As far as possible freak lay-outs have been avoided, and such arrangements as 6, 9, and 18 cylinder Y engines, which have, I think, from time to time been suggested, are not included, as the balance or firing order becomes impossible.

As a general principle, the graph shows that one of the first considerations is the desirability of approaching as nearly as possible perfect balance.

Heading No. 5 has been obtained by taking an area enclosing the cylinders and cooling gear, plus the area of a circle enclosing the engine bearers.

Such a compilation is hard on the radial, in the light of the latest experiences on cowling, and complimentary to the larger in-line engine, for the reasons stated elsewhere in this paper, and alternative figures have been given which are considered to most nearly represent a fair comparison. These alternative figures are based on results obtained on wind-tunnel work in this country and the recent N.A.C. American report.

I have made no attempt to alter the curves in respect to the large in-line air-cooled engines, but I seriously submit that when a sufficient air flow has been provided the frontal area will be increased.

For heading No. 6 an allowance of 0·32 sq. in. per b.h.p. has been made, equivalent to 20 cub. ft. required per b.h.p. at a speed of 100 m.p.h.

Heading No. 7 is certainly open to criticism and is purely empirical, as so much depends upon quantity, production, class of workmanship, etc.

It has been assumed that the first two categories are intended for the smaller classes of commercial aircraft, where price is of the utmost importance, whereas the third and fourth categories are intended for military and large commercial aircraft, where the highest class of workmanship is desirable.

An accurate figure for heading No. 8, without investigating the design details of each engine, is impossible, but the results are obtained from another graph, not shown, in which the standard wt./h.p. was plotted against a considerable number of different engines already in existence, and where it has been assumed that an air-cooled engine of given type and size would weigh the same as the corresponding water-cooled engine dry.

If conclusions are permissible from such a heterogeneous collection of data, I would like to add the following comments on the four categories of engines :—

The 80 *to* 100 *h.p. Light 'Plane Engine.*—In spite of the unbalanced forces in the four-cylindered in-line engine, the fact that it has already given excellent service is an argument in favour of it being, most probably, the best compromise.

Reasonable balance, combined with low cost, are more important that specific weight in this category. Psychology also plays its part on this type, and the fact that the in-line engine more nearly approaches the motor-car engine has, I believe, affected its popularity.

The six-cylinder in-line would appear to be a good lay-out for the more expensive type of engine.

I am not in favour of upside-down in-line engines for the light 'plane ; they are more vulnerable than the radial on a crash, and the induction system is difficult.

We seem to be some way off the £100 engine, but I believe the five-cylinder radial could be made a most excellent and cheap production job. I should be very intrigued to try out a five-cylinder radial in which the cylinders and crank-case were cast iron in one piece, with end aluminium casings for covers with aluminium-cast heads and duralumin-articulated rods. I believe that with reasonable production a sound engine could be produced very cheaply.

The 200 to 250 *h.p. Engine.*—In this category, where price and simplicity are still of considerable importance, the radial family would seem to be able to hold the field. The objections to the eight-cylinder horizontally opposed are obvious. The eight-cylinder Hex is excellent from a balance point of view, but probably more expensive than the single bank radial.

The 350 *to* 450 *h.p. Engine and the* 500 *to* 600 *h.p. Engine.*—The qualities required from the last two categories are approximately the same, except that the larger engine demands a greater number of cylinders, and, allowing that it will probably be installed in slower machines where gearing will be necessary, the cooling difficulties will be considerably greater.

The Wright Vee 1460 is a very interesting engine indeed, and represents the very latest practice in compact air-cooled in-line layout, for which so much has been claimed of late.

The burning question is how much less drag, compared with the radial, will an engine of this type give when the opening in the cowling is sufficient to provide the necessary cooling air to each cylinder.

Without in any way criticising the in-line Wright engine as a design, I believe the radial will require a good deal of displacing, at any rate for the third category, provided it can be installed in a suitable manner.

The drawings on p. 172 show in diagram form and to scale, two similar machines, with 9-cylinder radial and 12-cylinder Vee air-cooled engines, of approximately 400 b.h.p. In the case of the radial engine machine the drag has been reduced by a suitable lay-out and engine cowling, and the weight of the aircraft with radial engine will be undoubtedly less.

In the large engine category the radial family should all score on weight, cost and maintenance. The drag depends upon the type of machine and consequently the body behind the engine.

If the machine is such that the body allows a complete fairing to the engine the drag will probably approach that of the in-line engines, and the cooling should certainly be an easier proposition than on the latter.

The horizontally opposed 12-cylinder looks to be a very useful engine for multi-engine machines.

In conclusion, I would like to thank all those firms, both in England and America, who have so readily come forward with information, without which this paper would have been impossible, and also Messrs Owner and Fraser, of the Bristol Engine Department, for assistance in compilation of the tables.

The Autogiro in America

FOLLOWING on the purchase of an Autogiro in August last by Mr. Harold F. Pitcairn of Land Title Building, Philadelphia, negotiations have now been completed for the sale of the United States rights in the invention to the Pitcairn Cierva Autogiro Company of America, Incorporated, a Delaware Corporation. The Cierva Autogiro Co., Ltd., of Bush House, London, also retains a substantial interest in the American Company. The new Company will grant licences to manufacturers and others to make, use and sell the Autogiro throughout the United States. The interest of the purchasers in the Autogiro dates back to 1925 when Mr. Pitcairn visited Senor de la Cierva in Madrid. Since that time he has kept in touch with the development of the invention in England and a machine was taken over in the autumn of last year to Philadelphia where a series of practical flight tests were made under the direction of Mr. Pitcairn and his executive and engineering staffs. These tests which were of a very complete and thorough nature have resulted in the formation of the American Autogiro Company mentioned above.

Air Chartering

THE first charter for air transport was signed on February 15, the signatories being S. Instone and Co., Ltd., and Imperial Airways, Ltd. The charter was compiled by the former, the main point about it being that it introduces into air transport the same principles as those in shipping and facilitates the employment of aircraft for business purposes. The innovation has been well received in the City and business circles.

High-Speed Flight Appointment

FLYING OFFICER H. R. D. WAGHORN, an instructor at the Central Flying School, near Stamford, Lincolnshire, has been appointed to the High-speed Flying Section, Felixstowe, where practice is going on for this year's Schneider Trophy Race.

AIRISMS FROM THE FOUR WINDS

Australia-England Flight

PREPARATIONS for the proposed flight from Australia to England have been completed by Sqdr.-Ldr. Kingsford Smith and Flt.-Lt. Ulm, the two Australians who flew the Pacific. They will probably start any moment from Richmond Aerodrome, N.S.W., although the official start will be made from Wyndham, West Australia. It is hoped to accomplish the distance in 13 days, involving considerable night flying. Heavy rain may cause a delay at Wyndham, and tropical storms may be encountered over Java and as far as Calcutta. A non-stop flight from Singapore to Rangoon may be attempted during the journey, and the course will continue then through Allahabad, Karachi, Baghdad, etc., with possible intermediate landings at Calcutta and Rome. The machine is the Fokker monoplane *Southern Cross*.

Kenya Colony-London Flight

CAPT. MALCOLM BLACK landed at Croydon in Mr. John Carberry's Fokker monoplane on February 20, having started from Nairobi, Kenya Colony, eight days previously. He was accompanied by Mrs. Wilson and a mechanic, Mr. A. W. Watkins. The time for the journey was the fastest on record, although two days were spent in sight-seeing.

New Atlantic Flight Contemplated

COL. JAMES FITZMAURICE, the Irish airman who crossed the Atlantic in the "Bremen" monoplane last year from east-to-west with the late Baron von Hueneveld and Capt. H. Koehl, is reported to be preparing for a second attempt with Capt. H. Koehl as a fellow pilot again. The proposed course is from Berlin to New York in a Junkers machine fitted with floats and equipped with three engines. A southern route will be followed, touching at Lisbon and the Azores, and it is stated that the machine will be refuelled in flight. The entire crew will number four, and wireless apparatus will be installed.

In the centre of this group taken on board the United States liner "Leviathan" on its arrival at Southampton recently, is Major C. M. Young, of the United States Department, who is making an air tour of European aerodromes and airways on behalf of the American Government. He is flying a Stearman biplane fitted with a Wright "Whirlwind" engine (under the tarpaulin behind him). On the right is Capt. R. J. Goodman Crouch, of the Air Ministry, and on the left is Mr. C. C. Maidment, mechanic to Major Young. He accompanied Col. C. Lindbergh as mechanic on the tour of America after the Atlantic flight.

Rapid French Flight to the East

THE two French airmen, M. Paillard and Lieut. Le Brix, who left Paris on February 19 on a trial mail flight to Saigon, Indo-China, reached Cairo early on February 20. The following day they flew from Cairo to Basra, a distance of 937 miles, in 9 hrs. 25 mins. They left then for Karachi, and were next reported at Calcutta, after flying from Allahabad on February 24. The following day they flew to Akyab and Rangoon, the latter stage being covered in three hours, which is reported as a record. Saigon, their destination, was expected to be reached on February 26, after a short stop at Bangkok. Their machine is a *Bernard* cabin monoplane fitted with a 450 h.p. Lorraine-Dietrich engine.

To China by Light 'Plane

Two Chinese airmen will leave London shortly in a Cirrus-Avian light 'plane for Nanking—the first attempt to fly from England to China in a British machine.

"Graf Zeppelin" Plans

THE airship *Graf Zeppelin* will start on its proposed Mediterranean cruise on March 26, according to latest reports, although it was stated last week that the cruise was abandoned. If the German Foreign Office is unable to obtain authorisation for the airship to fly over any particular Mediterranean country, say Egypt, that part of the route will be altered. The proposed route is France (the Rhône Estuary), Corsica, Italy (Rome), Greece, Asia Minor, and the African coast.

Windsor, Ont., to Havana Non-Stop

MR. GEORGE HALDEMAN, who accompanied Miss Ruth Elder on her unsuccessful transatlantic flight last year, has completed a non-stop flight from Windsor, Ontario, to Havana, a distance of about 1,500 miles.

A Record Canadian Air Mail Delivery

EIGHT HOURS and ten minutes from Ottawa to Halifax was the record for air mail delivery set up by three planes of the new Ottawa-Montreal-St. John-Halifax service on February 4.

Antarctic Discoveries

COMMANDER R. BYRD has claimed new territory for America in the Antarctic, which he has named *Marie Byrd Land*, after his wife. This newly-discovered area lays between his base in the Bay of Whales and Graham Land, where Sir Hubert Wilkins carried out his aerial survey, recently, with good results. About 40,000 square miles have now been surveyed by Commander Byrd's expedition, according to his reports sent to the *New York Times*.

New Expedition for the Antarctic

THE Commonwealth Government of Australia has decided to organise and equip an Antarctic expedition led by Sir Douglas Mawson, and leaving Australia the end of this year. The object will be to explore the region lying south of Australia, and extending from Ross' Land, on the east, to Enderby Land, on the west. The British Government has generously placed the vessel *Discovery* at the disposal of the expedition, free of charge. Aircraft will be used.

Business Magnate's Air Tour

MR. VAN LEAR BLACK, the American business magnate who has adopted air transport for his business travels in many parts of the world, reached Cairo from Athens on February 21 in his Fokker monoplane (three Wright "Whirlwinds"). He was next reported at Khartoum, which he left on February 25 for Mongalla. He is accompanied by two Dutch pilots and his valet.

Atlantic Airman's Post

COL. C. LINDBERGH has been appointed technical adviser to the aeronautical branch of the U.S. Commerce Department.

FLIGHT

THE ROYAL AIR FORCE

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified :—

General Duties Branch

Wing Commanders : F. L. Robinson, D.S.O., M.C., D.F.C., to Station H.Q., Duxford, to command temporarily ; 11.2.29. G. H. Bowman, D.S.O., M.C., D.F.C., to R.A.F. Depot, Uxbridge, pending posting ; 6.2.29. H. L. Reilly, D.S.O., to Air Ministry (Signals Branch) for air staff duties ; 18.2.29. C. W. Nutting, O.B.E., D.S.O., to R.A.F. Depot, Uxbridge, pending posting, 18.2.29.

Squadron Leader F. H. Coleman, D.S.O., to No. 24 Sqdn., Northolt, 14.2.29.

Flight Lieutenants : J. Cottle, M.B.E., D.F.C., to Night Flying Flight, Biggin Hill ; 18.2.29. C. F. Le Poer Trench, to No. 32 Sqdn. Kenley, 21.2.29. A. R. Jones, to Central Flying Schl., Wittering ; 11.2.29. J. F. Clark, to R.A.F. M.T. Depot, Shrewsbury ; 13.2.29. V. Croome, to No. 23 Sqdn., Kenley ; 20.2.29. L. M. Elworthy, to R.A.F. Depot, Uxbridge ; 31.1.29. F. F. Garraway, to R.A.F. Depot, Uxbridge ; 26.1.29. A. P. White, to R.A.F. Depot, Uxbridge ; 5.2.29. G. M. Lawson, M.C., to No. 216 Sqdn., Middle East ; 4.2.29. W. K. Mercer, to No. 20 Sqdn., India, instead of to No. 31 Sqdn., as previously notified. N. V. Wrigley, to R.A.F. Base, Gosport ; 1.3.29. R. V. M. Odbert, to H.Q., Wessex Bombing Area, Andover, 2.3.29.

Flying Officers : J. A. C. Florence, to Home Aircraft Depot, Henlow ; 12.2.29. R. C. Whitle, to Armament and Gunnery Schl., Eastchurch ; 17.2.29. C. W. Dicken, to R.A.F. Base, Calshot ; 18.2.29. R. Brown, to R.A.F. Base, Gosport ; 5.1.29. C. C. Edwards to No. 45 Sqdn., Middle East ; 9.2.29. B. W. Knox and W. L. Robertson, to R.A.F. Depot, Uxbridge ; 31.1.29. H. S. Dawe, to No. 43 Sqdn., Tangmere ; 26.2.29.

Pilot Officers : K. A. K. MacEwen, to No. 2 Flying Training Schl., Digby, on appointment to a Permanent Commn. ; 25.1.29. R. W. M. Clark, to No. 2 Armoured Car Co., Middle East ; 2.2.29. H. L. McCulloch, to R.A.F. Depot, Uxbridge ; 3.2.29. A. D. Bennett, to No. 403 Flight, China ; 15.2.29. H. W. Duffey, W. P. J. Thomson and M. R. Kelly, to No. 5 Sqdn., India, instead of to Aircraft Depot as previously notified. The undermentioned Pilot Officers are all posted to the R.A.F. Depot, Uxbridge, on appointment to Short Service Commns., with effect from 22.2.29 :—R. J. Axten, R. E. H. Beaton, E. D. Bishop, G. H. A. Blackwood, A. F. C. Booth, R. C. A. Brooke-Beer, E. A. Cooke, R. A. Davies, C. S. Gill, F. R. W. Goad, T. W. Hoyle, M. M. Jackson, L. E. Jarman, E. H. Jennings, G. P. Longfield, G. P. Marvin, V. R. Moon, G. E. Mustard, P. J. Pratt, H. D. Primrose, W. M. Rankin, G. N. Roberts, H. L. Smith, D. W. Smyth, R. M. Swaine, A. C. Watson, and T. H. Wilson.

Stores Branch

Squadron Leader : F. Anderson, to H.Q., Fighting Area, Uxbridge ; 18.2.29.

Flight Lieuts. : T. S. James, to R.A.F. Base, Calshot ; 12.2.29. R. G. Gore, to R.A.F. Depot, Uxbridge ; 3.2.29.

Flying Officers : A. J. Cox, M.B.E., to R.A.F. Reception Depot, West Drayton ; 13.2.29. L. J. V. Bates, to H.Q., Air Defence of G. Britain, Uxbridge ; 3.2.29. A. A. Quayle, to Aircraft Depot India, 12.2.29.

Accountant Branch

Wing Commander : C. G. Murray, O.B.E. to No. 1 Schl. of Tech. Training (Apprentices), Halton ; 11.2.29.

Squadron Leader : A. Holmes, to H.Q., Cranwell ; 22.1.29.

Flight Lieut. : H. A. Murton, to Station H.Q. and Storage Section, Andover ; 11.2.29.

Flying Officers : R. W. L. Glenn, to No. 100 Sqdn., Bicester ; 12.2.29. E. Smith, to H.Q., Coastal Area ; 14.2.29. J. E. Gregson, to No. 12 Sqdn., Andover ; 11.2.29. L. Chegwidden, to No. 13 Sqdn., Andover ; 10.2.29. C. B. Rawlins, M.C., to R.A.F. Depot, Uxbridge ; 19.1.29.

Medical Branch

Flight Lieut. : E. D. D. Dickson, M.B., F.R.C.S. (E.), D.L.O., to R.A.F. Depot, Uxbridge ; 3.2.29.

Flying Officer : P. J. McNally, M.B., to Med. Training Depot, Halton, on appointment to a Short Service Commn. ; 12.2.29.

IN PARLIAMENT

National Flying Services, Ltd.

THE PRIME MINISTER, on February 10, asked by Capt. Garro-Jones if he would give an early opportunity for discussing the proposed subsidy to National Flying Services, Ltd., replied that when the Air Estimates were before the House would be the appropriate occasion for raising the matter.

Capt. Garro-Jones asked if, in view of the fact that when the estimates came forward it would be too late to prevent the scheme going through, the Prime Minister would be prepared to receive a deputation to state the case for an early discussion.

Mr. Baldwin : No, it will not be too late at all. The Air Estimates will be taken in the next fortnight. No money can be paid until the House of Commons gives its sanction.

In answer to a further question, Mr. Baldwin said : The Minister for Air has always power to make grants, subject to the sanction of Parliament, in any direction that he thinks will aid civil aviation. But he has no control over any company or body to which he may suggest giving a grant, and if they choose to issue a prospectus and form a company he cannot prevent them. If such a prospectus appears before the debate takes place it will be stated perfectly in that prospectus that the giving of a grant entirely depends on the Parliamentary vote that will take place.

France and Air Expenditure

SIR SAMUEL HOARE, in reply to Comdr. Bellairs, said the total vote for French air expenditure for 1929 is 1,821 million francs. Owing to the classification of the votes, it is not possible to give accurate figures for expenditure on the Air Force as opposed to civil aviation.

National Flying Services, Ltd.

SIR PHILIP SASSOON on February 18 in reply to Captain Garro-Jones said as to the National Flying Services, Ltd. agreement, the Air Ministry had received a few inquiries relating to the operation of the scheme, including in some instances expressions of anxiety as to its possible reactions. He had satisfied himself that no existing interests would be prejudicially affected, and that, manifest advantages would accrue both to the State and the general public, if the project met with success. He therefore certainly proposed to proceed with the scheme.

Air Mail.

THE POSTMASTER-GENERAL, SIR WILLIAM MITCHELL-THOMSON, on February 19, replying to Mr. Day, said during the year 1928 about 160,000 letters originating in the United Kingdom were carried abroad by air mail. In addition, about 350,000 were sent abroad by ordinary mail for subsequent conveyance by air mail.

Air Services of Ceylon

SIR H. BRITTAIN, on February 21, asked the Secretary of State for Air whether, having regard to the importance of Colombo as the capital of a colony of industrial importance, the question of linking up the colony with the air route to Australia has been considered ; and what progress, if any, is being made in the scheme of a Bombay-Colombo air service ?

Major Sir Philip Sassoon : I understand that the question of linking up Colombo with the proposed trunk air line across India to Rangoon and beyond has been considered by the Government of India, but progress cannot be made with such a scheme pending the inauguration of the main route. It is mainly a question for the Government of India, and they are fully alive to the importance of the matter.

Light Aeroplane Clubs and Assistance

MR. HAMMERSLEY, on February 25, asked the Secretary of State for Air whether he is prepared to grant, under similar conditions, to established flying clubs, as for example the Lancashire Aero Club, the same Government assistance as that which he proposes to grant to National Flying Services, Ltd., for the training of pilots ?

Sir Samuel Hoare : The 13 subsidised light aeroplane clubs, including the club mentioned, are already receiving Government assistance on a much more liberal scale than that proposed for National Flying Services, Ltd., while they are under no similar obligation as regards the provision and maintenance of a chain of aerodromes and landing grounds as a condition of the grant of the subsidy. No change is contemplated in the agreements under which the existing light aeroplane clubs are subsidised.

Mr. Hammersley asked if he was aware that there are quite a number of undertakings which specialise in this type of flying, and are successful and expanding, and does he think that it is fair that they should be subject to Government subsidised competition ?

Sir S. Hoare : I think that had better be discussed on the Air Estimates, but may I say in a single sentence that under the National Flying Services, Limited, the subsidy for pilots is £10 per pilot, whereas at present we are paying to the light aeroplane clubs £40 to £50 per pilot. The agreements run in most cases for nearly two years further.

PERSONALS

Married

The marriage took place on February 12, at the Church of the Holy Cross, Cowbridge, Glamorgan, of FLYING OFFICER MORGAN RICE EDMONDES, younger son of the late Maj. Charles Edmondes, of Old Hall, Cowbridge, and Mrs. Charles Edmondes, O.B.E., J.P., of St. Hilary, Cowbridge, and Miss MARJORIE FLORENCE HARRISON, younger daughter of Mr. and Mrs. E. A. Harrison, of Penllyn, Cowbridge.

WING COMMANDER W. TYRRELL, R.A.F.M.S., eldest son of the late John Tyrrell, Belfast, and Bangor, Co. Down, was married on February 12, at St. Columbas, Pont Street, London, to BARBARA COLECLOUGH, daughter of the late James Coleclough, Romsey, and Mrs. Coleclough, Southbourne, Hants.

To be Married

The engagement is announced between FLIGHT-LIEUT. FREKE WILLIAM WISEMAN-CLARKE, R.A.F. (Lieut.-Com., R.N., ret.), only son of Mr. and Mrs. Wiseman-Clarke, of 61, Cadogan-square, S.W., and CYNTHIA MARY, only daughter of MAJ. and MRS. PEMBERTON, of 6, Bedford-gardens House, Campden Hill, W.

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R.A.F. Boxing Championships

AT Halton Camp the boxing championships for the R.A.F. were contested on February 21. The following were the results :—*Officers* :—Welter-Weight.—Final.—Flying Officer Dewhurst (Sealand) beat Flying Officer Loughman (Catterick) (holder), who was counted out in the first round. Light-Heavy-weight.—Final.—Flight-Lieut. McLean (Worthydown) beat Flying Officer Tattersall (Henlow) on points. Light-Weight.—Final.—Flying Officer Watkins (Farnborough) w.o. Heavy-Weight.—Final.—Flying Officer Beamish (Grantham) w.o.

Aircraft Apprentices :—Midge-Weight.—Final.—A. A. Hobbs (Halton) beat A. A. Smith (Halton) on points. Fly-Weight.—Final.—A. A. Beale (Halton) beat A. A. McPhearson (Halton) on points. Bantam-Weight.—Final.—A.A. Rothwell (Ruislip) beat A.A. Jones (Ruislip) on points. Feather Weight.—Final.—A.A. Hughes (Halton) beat A.A. White (Halton) on points. Light-Weight.—Final.—A.A. Hall (Halton) beat A.A. Porter (Halton) on points. Welter-Weight.—Final.—A.A. Wright (Flowerdown) beat A.A. Sweetland (Halton) in the second round. Middle-Weight.—Final.—A.A. Grover (Halton) beat A.A. Kenning (Ruislip) in the second round. Mosquito-Weight.—Final.—A.A. Keast (Halton) w.o.

Airmen's Events :— Fly-Weight.— Final.— Aircraftman Cooper (Digby) (holder) beat Aircraftman Dossett (Henlow) on points. Bantam-Weight.—Final.—Aircraftman Williamson (Henlow) (holder) beat Aircraftman Johnson (Henlow) on points. Feather-Weight.—Final.—Corporal Blaze (Halton) (holder) beat Aircraftman Scroggins (Coastal Area) in the first round. Light-Weight.—Final.—A. C. Varley (Martlesham Heath) beat Aircraftman Clarke (Cranwell) on points. Welter-Weight.—Final.—Aircraftman Buchanan (Manston) beat Aircraftsman Fancy (Netheravon) in the second round. Middle-Weight.— Final.—Aircraftman Clapp (Old Sarum) beat Aircraftman Nee (Uxbridge) on points. Light-Heavy-Weight.—Final.—Aircraftman Munkley (Henlow) beat Aircraftsman Spinks (Hendon) in the first round. Heavy-Weight.—Final.—Aircraftman Dean (Manston) beat Aircraftman Hadlow (Grantham) in the second round.

WESTLAND AIRCRAFT SOCIETY

AT a meeting of the Society held on February 6 an interesting lecture was given by Mr. A. H. Caple, of A.D.C. Aircraft, Ltd., on the subject of "Cirrus Aero Engines."

The lecturer gave a brief history of the development of the Cirrus engine commencing in May, 1925, when the light aeroplane movement first came into prominent activity. There was a need for an aero engine which could be maintained and operated by anyone possessing an average knowledge of car engines, and the "Cirrus I" was the first low-powered aero engine coming within this category which passed the Air Ministry 100-hour type test. This engine delivered 60 h.p., but this was soon deemed inefficient for normal light aeroplane requirements, and as a result the "Cirrus Mk. II" engine, developing 80 h.p., was produced. It was with this engine Mr. Bert Hinkler made his notable flight to Australia, covering 12,000 miles in 15½ days. A demand for reserve power again called for further developments, and the Mk. III engine, developing 90 to 100 b.h.p., resulted. The constructional details of the Mk. II and Mk. III engines were discussed in some detail, the various points being shown in a series of excellent slides.

The lecturer then made the interesting announcement that a still later design—the Hermes engine—would shortly be placed on the market. This engine, with a nominal rating of 100 to 110 h.p., actually develops 105 b.h.p. at the normal revolutions of 1,900. A number of interesting particulars were given regarding this engine, but a complete description is not yet available for general publication. The engine is a four-cylinder in line, air-cooled engine, with a magneto arranged on each side of the crankcase, facing forward (instead of the Cirrus arrangement of two magnetos on one side of the engine facing each other). The general lines of the engine are very good from the cowling point of view, and the overall length has been actually decreased compared with the Cirrus. It says a great deal for the designers that the weight of the Hermes engine is the same as for the "Cirrus III," *i.e.*, under 300 lb., although the engine gives a considerable increase in power. The Hermes engine is arranged so that it can be installed on the same engine bearers as for the Cirrus series.

After the lecture several questions were put and ably answered. Mr. H. J. Penrose asked whether the A.D.C. Aircraft, Ltd., had found whether varying the form and position of the air intake pipe had any noticeable effect on carburation. Mr. Caple replied to the effect that the position of the air intake pipe was usually governed by questions of installation. The wind velocities certainly differed considerably in different points on the 'plane. It had been found that there was a considerable difference on the left-hand side of the engine as compared with the right hand—due, of course, to the direction of rotation of the propeller and the slip stream—and in one case a movement of the air intake pipe only 2 in. had made a difference of some 30 to 40 r.p.m. on the engine.

In reply to a second question the lecturer stated that although the old types of cowling had been effective, the later and more efficient design engine demanded something better, and tests were being made in order to develop a type of cowling which would suit the majority of installations.

Mr. Douglas Seaton asked the lecturer whether any experiments had been made in connection with super-charging the Cirrus engines. He replied to the effect that tests had been made but unofficially, and in his opinion it was doubtful whether the gain was justified for the class of work for which the engine was intended.

Mr. Coulson asked whether any experiments with geared engines had been made. In reply, the lecturer stated that a study of the polar diagrams of inertia and turning moment showed that it would be very difficult to fit a gear to a four-cylinder engine which would stand up to the extremely high periodic stresses, and that it would be necessary to fit a flywheel in order to get a gear which would stand up to the work.

A hearty vote of thanks was proposed by Mr. V. S. Gaunt, Hon. Secretary of the Society.

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Prince of Wales Interested in Aircraft Instruments

THE aircraft instruments exhibited by the Accurate Recording Instrument Co. Ltd., of Aric Works, Manor Road, Teddington, Middlesex, at the British Industries Fair, White City, London, attracted the interest of H.R.H. The Prince of Wales during his visit on February 19. He was gratified to learn that the company was doing good business and extending its activities abroad.

Pratt and Whitney Engines in Canada

AN announcement was recently made at Montreal of the formation of the Canadian Pratt and Whitney Aircraft Co., Ltd., which has leased a portion of the plant of the Charles Walmsley Co., at Longueil. The company expected to start production this month, and it is planned at first to confine operations to assembling, overhauling and servicing, and later to take up manufacturing parts as conditions warrant. The president of this new company is Mr. James Young of Montreal (formerly director and vice-president of Messrs. John Bertram and Sons, Ltd.), and other Canadians on the directorate are Mr. C. H. Duggan (president of the Dominion Bridge Co. and Dominion Engineering Works), Mr. Ross H. McMaster (president of the Steel Co. of Canada, Ltd.), Mr. G. Montague Black and Mr. H. G. Welsford (General manager of Dominion Engineering Works).

A Change of Telephone Number

Will readers please note that the Telephone Number of the H. G. Hawker Engineering Co., Ltd., is now "Kingston 6272" (4 lines).

Cellon, Ltd.

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Australian Aviation News

AUSTRALIAN Aerial Services, Ltd., of Melbourne, report that Lady Stonehaven flew from Melbourne to Jerilderie in the *Wattle Bird* on December 6 last, and on December 29, Lord Stonehaven, the Governor-General, chartered the *Bell Bird* to enable him to witness the test match at Melbourne. Chief Pilot Briggs made a flying inspection tour of the company's landing grounds in the Riverina, and gave many station owners and their families short flights. A considerable increase in passenger traffic was reported in December, and the company had to refuse some passengers. Confidence in the services is evidenced by the number of children carried.

* * * *

PUBLICATIONS RECEIVED

The Journal of the Royal Air Force College, Cranwell, Lincs. Vol. IX, No. 1. Gale and Polden, Ltd., Aldershot.

Aeronautical Research Committee Reports and Memoranda. No. 1174 (*Ae.* 338).—Wind Tunnel Tests with High Tip Speed Airscrews, Some Experiments upon an Airscrew of Conventional Blade Section, Aerofoil R. & M. 322, No. 3, at High Speeds. By G. P. Douglas, D.Sc., and W. G. A. Perring, R.N.C. July, 1928. Price 9*d.* net. *No.* 1175 (*Ae.* 339).—An Analysis of a Rectangular Monoplane with Hinged Tips. By S. B. Gates, M.A. January, 1928. Price 1*s.* net. *No.* 1178 (*Ae.* 342).—The Change in Airscrew Characteristics with Height. By A. E. Woodward Nutt, B.A. August, 1928. Price 9*d.* net. H.M. Stationery Office, Kingsway, London, W.C.2.

A.B.C. of Aviation. Elementary Edition. By V. W. Page. The Norman W. Henley Publishing Co., 2, West 45th Street, New York. Price 1 dol. net.

Aeronautical Research Committee Reports and Memoranda: No. 1171 (*Ae.* 335).—The Theoretical Relationships for an Aerofoil with a Multiply-Hinged Flap System. By W. G. A. Perring, R.N.C. April, 1928. Price 9*d.* net. *No.* 1176.—The Boundary Layer of the Front Portion of a Cylinder. By A. Thom, B.Sc., Ph.D. July, 1928. Price 1*s.* net. *No.* 1180 (*Ae.* 344).—The Inclusion of Partial Glides in Routine Performance Tests. By A. E. Woodward Nutt, B.A. May, 1928. Price 4*d.* net. *No.* 1182 (*Ae.* 346).—Rolling Experiments on an Aerofoil of R.A.F. 32 Section. By H. B. Irving, B.Sc., and A. S. Batson, B.Sc. Sept., 1928. Price 6*d.* net. H.M. Stationery Office, Kingsway, London, W.C.2.

Sea Slang: Dictionary of the Old-Timers' Expressions and Epithets. By Frank C. Bowen. Sampson Low, Marston Co., Ltd., 100, Southwark Street, S.E. Price 3*s.* 6*d.* net.

The Lightest of the Common Metals. The British Aluminium Co., Ltd., Adelaide House, King William Street, London, E.C.4.

Motor Boat Manual. Temple Press, Ltd., 5–15, Rosebery Avenue, London, E.C.1. Price 5*s.* net.

Catalogue

Wild-Barfield Electric Furnaces. Wild-Barfield Electric Furnaces, Ltd., Elecfurn Works, North Road, London, N.7.

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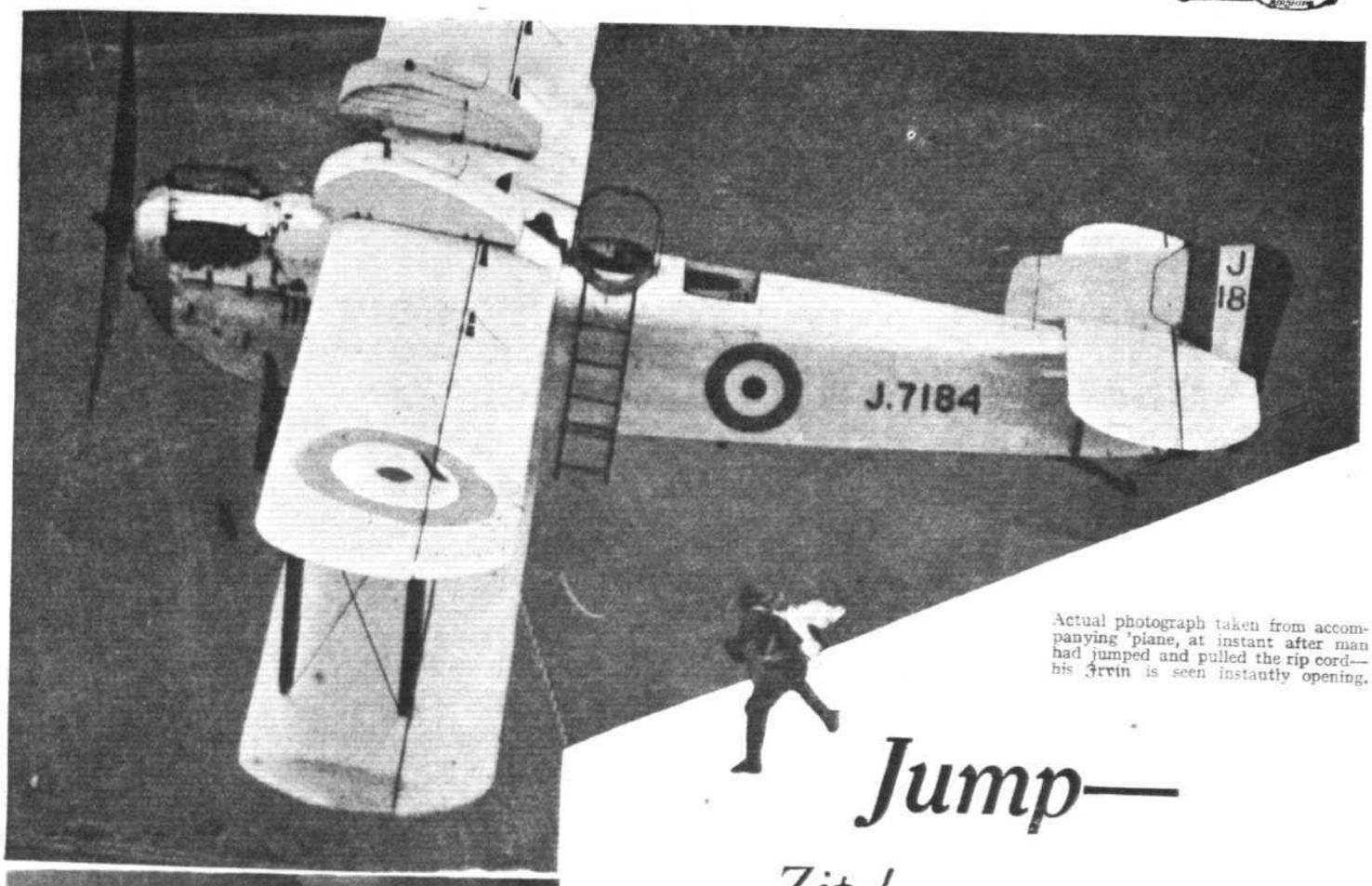

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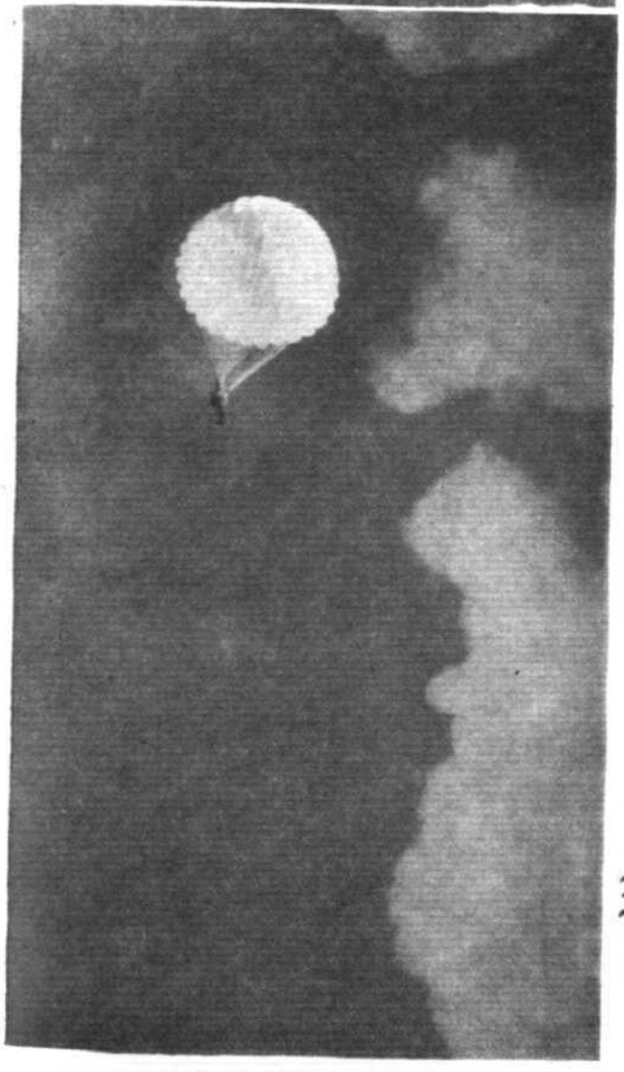

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